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UNIVERSITY OF ALBERTA

RETAINED OWNERSHIP OF BEEF CALVES IN ALBERTA: A SIMULATION

BY

EARL V. MUNRO

A thesis submitted to the faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Master of Science in:

AGRICULTURAL ECONOMICS

DEPARTMENT OF RURAL ECONOMY

EDMONTON, ALBERTA

FALL 1993

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ISBN 0-315-88162-3

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled RETAINED OWNERSHIP OF BEEF CALVES IN ALBERTA: A SIMULATION submitted by EARL VICTOR MUNRO in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in AGRICULTURAL ECONOMICS.

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Abstract

This study investigates the risk and return of retained ownership of steer calves past weaning, in Alberta. The study is approached using two methods, the first is an option value approach and the second is an historical simulation.

The option value approach indicates that the option to retain ownership is small or non-existent, however additional research may further develop the method presented.

The base simulation model is based on a producer retaining 100 beef steers every fall for the years 1979 to 1991. There are three weaning weights examined being four hundred and fifty, five hundred and fifty and six hundred and fifty pounds. In addition to the base model a further simulation is developed to examine selective hedging strategies.

Participation in the National Tripartite Stabilization Program has been a benefit to producers who retain ownership, both in terms of increased return and decreased risk. Selective hedging strategies, based on a target return, can increase returns and decrease the level of risk. A routine hedge was not found to be a successful risk management tool over long production horizons.

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CHAPTER 1 INTRODUCTION

Cattle sales in Alberta account for a large portion of the farm generated cash receipts. During 1990 alone, 1.558 billion dollars (36.7% of cash receipts) of cattle were traded.[1] There has been a trend in agriculture towards more specialized farms and ranches. With specialization in the cattle industry towards larger feedlots, cow-calf producers have moved towards selling their calves at weaning. Many cow-calf producers in Alberta do not have the required facilities to feed their calves to market weight. An option available to the cow-calf producer is to place the calves in a custom feedlot where they will be fed to market weight. By doing this the cow-calf producer retains ownership of the cattle and at is afforded the advantage of a feedlot with functional facilities.

The decision to place the calves in a custom lot, in part, depends on the expected profitability and risk. Many studies have been completed that look at the cattle feeding industry and examined the risks and returns, thereof. The most recent of these are Unterschultz (1991) and Freeze et. al. (1990). Both of these studies address the question of profitability and risk from buying and feeding heavy feeder calves through to slaughter.

---

1 Alberta Agriculture, Agriculture Statistics Yearbook. (1990). Agdex 853-10 pp.11.

An Alberta study is required to address the question of retained ownership. There clearly is a need to understand the profitability and risk of retained ownership of beef calves through to heavy feeder and/or slaughter weight. When addressing profitability, the source and level of risk are important considerations. Income risk in cattle feeding in Alberta is due to variability in output, feed and purchase price, production variability, and changes to government programs.

Strategies available for Alberta producers to reduce price risk include: reduction of feeding periods, hedging cattle on feed, options on futures, forward price contracts, and participation in the National Tripartite Stabilization Program and other Government assisted or directed programs.

The purpose of this study is to measure the profitability and risk of retaining ownership of beef calves. Retained ownership is defined as the cow-calf producer holding his/her calves past weaning. In this study the period of time for retained ownership is from one month up to the point that the cattle are slaughtered.

The study is completed using two methods. The first is through the use of option values. An option value is that value over and above market value that can be attributed to the loss of an option. The second method is to develop an historical simulation that accurately reflects different management regimes from a profitability and risk management perspective. Employing data for the 1979 to 1991 calf crop

years, two separate simulations are completed. The first examines the profitability of retained ownership of beef calves in Alberta, and the second explores some potential marketing strategies.

Over the last thirteen years, many cow-calf operators have struggled to understand how best to use the information provided by the futures markets. Also during this time, government programs were introduced that directly affect the risk and returns of feeding cattle in Alberta. Models are developed to allow the producer different management regimes with various levels of flexibility. In addition, marketing strategies employing the futures markets are examined. These regimes are then compared using measures of return and risk.

1.1 Study Objectives

This study evaluates the returns and risk from retaining ownership of beef calves past weaning[2]. The objectives of this study are outlined below:

1. Review the concept of a option value and apply this theory to retained ownership of beef cattle;

2. Measure realized net returns from retaining ownership of beef steers in Alberta;

3. Compare different weaning weights and feeding strategies and the effect that each has on realized returns and variability in returns;[3]

4. Include and evaluate the National Tripartite Stabilization Program (NTSP) and include the Crow Benefit Offset Program, both introduced during the study period. The effect on returns and variability of returns is examined;

---

2 For the purposes of this report we have only examined the retained ownership of beef steer calves. It is expected that similar results would be applicable for heifer calves or a combination thereof, however no formal research is presented.

3 The three different weaning weights examined are 450, 550 and 650 pounds, there are six different feeding regimes examined as well. The specific regimes are presented later in this paper.

5. Review marketing strategies that could be integrated into existing cow-calf operations;

6. Investigate the Chicago Mercantile Exchange's live cattle futures contract and its viability as a marketing and risk management tool for retained ownership.

1.2 Study Plan

Chapter 2 investigates the cow-calf and cattle feeding industry in Alberta. Government programs instituted during the simulation period are discussed. Futures market are introduced along with the possible implications thereof.

Chapter 3 reviews previous studies of cattle feeding. In addition, risk measurement and risk management practices are reviewed. The factors that affect the price of calves and measurement techniques are addressed.

Chapter 4 explores the concept of an option value and adapts this theory to the cattle market. A quasi-option value is that value, over and above market value, attributed to the option to sell at a later date as information becomes available.

Chapter 5 reviews the data collected and employed throughout this report.

Chapter 6 presents the research methodology and results obtained from the historical simulation. An historical simulation of retained ownership of beef calves is completed and various weaning weights and feeding regimes explored. In addition, a simulation of different marketing strategies is completed and presented. These marketing strategies are examined as to their potential to increase realized returns and/or decrease risk. In both simulations, participation in the National Tripartite Stabilization Program (NTSP) and non-participation are considered.

Chapter 7 explains the implications of this study for producers and provides a guideline for further research. Limitations of the data and limiting assumptions made during the course of this report are discussed.

CHAPTER 2 CATTLE FEEDING IN ALBERTA

This chapter describes the cattle feeding industry in Alberta. An introduction to the cow-calf industry as well as the backgrounding and finishing operations are presented. Government programs that were in place or introduced during the simulation period are reviewed. A review of custom feedlots is given along with a brief introduction to futures markets. Any possible impacts to net income and risk are discussed.

2.1 Background

The cattle industry in Alberta is an important source of income to Alberta farmers. There are three major types of cattle producer in Alberta, the cow-calf producer, backgrounder and finisher. Many farms combine one or more of the above into their cattle enterprise.

In recent years, farm managers have become more specialized in the production of cattle. The cow-calf producer tends to specialize in the production of calves for sale in the fall. At that time, the cattle are sold and either backgrounded or fed to slaughter weight. This specialization has led to a deterioration of the buildings and improvements required to feed the cattle to market weight.

An option open to the producer is to retain ownership of the cattle by placing the cattle in a custom feedlot. Custom feedlots allow the cow-calf producer to retain ownership of their calves past weaning without a large capital investment. This decision will be based, in part, on the profitability and risk of retained ownership. There is a need to address whether the cow-calf producer could add to his/her returns by retaining ownership past weaning.

2.2 Government Programs

Two major government programs were introduced during the period 1979 - 1992 which have had an impact on cattle feeding in Alberta. The first is the Crow Benefit Offset Program. The second is the National Tripartite Stabilization Program. In addition to these programs, other government programs were available during the study period. Most of these programs were project specific grants or loans, and as such have not been addressed in this report. These would included programs offered by Prairie Farm Rehabilitation Administration (PFRA), for example.

2.2.1 Crow Benefit Offset Program

The Crow Benefit Offset Program (CBOP) was introduced in September, 1985 by the Alberta Government to compensate feed grain users in Alberta for the statutory grain freight rate subsidy. The statutory freight rate subsidy is commonly

referred to as the crow freight rates. It was perceived by the Alberta government that the crow freight subsidy decreased the competitiveness of the livestock industry in Alberta. Therefore, a compensating subsidy, CBOP, was introduced. There is no cost to the producer for participation in the program. This program effectively reduces the cost of barley to the feedlot operator. For every tonne of feed grain used in Alberta, the user received a payment in the following amount:

Sept. 1985 to June 1987	$21.00 per tonne
July 1987 to Aug. 1989	$13.00 per tonne
Sept. 1989 to present	$10.00 per tonne

Almost all of the producers in Alberta belong to this program. The program applies to producers who retain ownership of their calves in a custom lot. Given that this program reduces production costs, it is felt that the program will enhance net income of cattle producers, at least initially. Whether the long term income of the cattle producer is enhanced or whether the less expensive feed costs have been included in the bid price of feeder cattle, is unknown. As the program is well defined and predictable, it is not expected to affect the level of risk.

During the simulation portion of this study, the cost of barley was calculated in the following manner. Any payments, under the CBOP were subtracted from the elevator price to arrive at a net cost of barley per tonne. The CBOP payments are often not received by the producer for up to six months after the barley has been purchased or fed, however, no carrying costs have been considered in this analysis.

2.2.2 National Tripartite Stabilization Program

The National Tripartite Stabilization Program (NTSP), designed to provide support for the producer in the face of falling prices and/or increasing production costs, was introduced in July of 1986. Retroactive payments to April 1986, were announced on the inception date. The NTSP is an insurance program based on historic price and cost information.

The premiums for this program are shared equally by the producer, the Provincial Government, and the Federal Government. The NTSP is scheduled to end in December 1995[4]. At the end of 1995 any deficit to the program will be shared equally by the Provincial and Federal Government and any surpluses will be distributed to the producers.

To participate a producer must register all of their cattle in the program. There are three basic NTS programs for cattle Producers:

1) The cow-calf program uses an indexed moving average of calf prices (IMAP). If the revenue per cow (calculated from calf prices) falls below 85% of the ten year moving average of revenue, a payout is triggered.

---

4 It has been announced that NTSP may end late in 1993.

This program payment is calculated at the time of weaning and payments are made as if the calves are sold at weaning. These payments are made regardless of whether the producer retains ownership or not. Since this study addresses only post weaning decisions, the impacts of this program are not included.

2) The slaughter cattle and feeder cattle programs, use a guaranteed margin (GM) approach to calculate support prices. The trigger point for the period April 1986 to December 1989 was 85% of the guaranteed margin based on quarterly calculations and switched to 90% based on monthly calculations from January 1989 onwards. Payments are triggered when the actual margin falls below the guaranteed margin or trigger point. Under both of the programs the cattle must remain on the farm for 60 days (2 months).

> "... The margin for any quarter is the weighted national average price for that quarter minus the weighted national average cash costs in the quarter. If the weighted national average market price for a quarter is below the support level for that quarter, a payment is effected. ..."[5]

3) The feeder cattle program was introduced in July 1988.

The premiums for both the slaughter and feeder cattle programs are shown in table 1.

---

5 Tan M.H. The National Tripartite Stabilization Program for Red Meats: Cattle Models. 1988. Agriculture Canada. Policy Branch. Working Paper 2/88. Page 23.

Table 1 NTSP Premiums

Slaughter Cattle		Feeder Cattle	
Period	$/hd	Period	$/hd
Jan. 1986 to Sept. 1987	6.60	June 1988 to Sept. 1990	4.85
Oct. 1987 to Mar. 1989	7.40	Oct. 1990 to Dec. 1991	5.50
April 1989 to end	8.10	Jan. 1992 to end	4.85

Producers may enroll in the feeder and slaughter cattle programs individually or together. If either program is joined separately, the producer pays the appropriate premium (either feeder or slaughter) when the cattle are placed on feed and receives the payout (if applicable) when the cattle are sold.

If both programs are joined the producer initially pays the slaughter cattle premiums. If the cattle are later sold as feeders, the producer receives payments under the feeder cattle program, as well as the difference between the two premiums. This difference in the premiums can be left as a credit on account or withdrawn on the date of sale. If the producer decides to feed the cattle to slaughter weight he/she would be entitled to any payments under the slaughter cattle program.

Discussions with Alberta Agriculture, Central Program Support indicate, that most producers are enrolled in both programs, if applicable.

The effects of this program are considered in the simulation portion of this study. For the purposes of this report, when the producer belongs to NTSP, it is assumed that the producer enrolls in both programs. Any premiums are added to the costs for the month in which they are incurred and any support payments are added to the gross revenue at the time of sale. Options of participating in and not participating in NTSP are shown in this study.

Since the program is only one third funded by the producers the net effect of the program is expected to increase revenues. The effect of these programs on the level of risk facing to the cattle producer is explored in this study.

2.3 Futures Markets

A futures contract is a contractual agreement, enforceable by law, to buy or sell a specified quantity and quality of a commodity at a future date[6]. Trading a futures contract is not the actual purchase or sale of the commodity, but a written promise to buy or sell at a predetermined time and place. Thus, ownership in the particular commodity is not a pre-requisite for selling.

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6 Hieronymous, T.A. Economics of Futures Trading for Commercial and Personal Profit. 1971. New York Commodity Research Bureau Inc.. New York. PP. 87.

A producer who considers retaining ownership has two futures markets for cattle that can be employed in a hedging program. These are the live and feeder cattle contracts on the Chicago Mercantile Exchange. The commodity employed in this report is live cattle.

When a futures contract is purchased or sold a deposit of money (margin) is required by the exchange to be used as security against adverse price movements. The margin for both a feeder cattle contract and a live cattle contract is assumed to be $1,000.00[7] US per contract in this study. In the event of an adverse price movement the producer may be required to increase the margin to ensure the proper level of margin is maintained (maintenance margin). The maintenance margin level is assumed to be $700.00 U.S. per contract during this study and it is assumed that margin is kept in a margin account for the length of time the contract is open.

In this study, when a hedge is placed, it is assumed that the producer sells future contracts (goes short) and buys them back at the end of the feeding period thus closing the contractual obligations. In addition, it is assumed that the producer hedges all of the production. This is referred to as a complete or full hedge. A routine hedge is defined by the producer placing a hedge for the full amount of

---

7 The margin and maintenance margin fluctuates depending on the price of the commodity as well as price volatility. It is assumed through out this study that they are $1,000.00 and $700.00 US, respectively. After speaking to representatives of Burns Fry Limited and Richardson Greenshields of Canada Limited, it was determined that the current levels are $540.00 and $400.00 US. It is also noted that they have been decreasing during the study period.

production, when production begins each and every period regardless of price. A selective hedge, on the other hand, is placed after the producer believes that some level of profit can be achieved. A selective hedger would then wish to be hedged when the price movements are disadvantageous and in the cash market when the price movements are advantageous[8]. In this study we have examined both the routine and selective hedge.

Evidence on whether future markets can be used in a risk management strategy by Alberta producers is mixed. Carter and Loyns (1985) concluded that the live cattle futures contract could not be used to decrease risk for a Canadian producer, whereas Unterschultz (1991) found that the risk could be reduced using the live cattle futures market. In most cases, however, such strategies lead to a decrease in both the level of risk and the level of income. This is known as the risk-reward trade-off.

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8 Purcell W. D. Agricultural Futures and Options. 1991. Macmillian Publishing Company, New York. pp. 358.

2.4 Custom Feedlots

Custom feedlots can be used by the cow-calf producer, who does not have the necessary improvements or feedlot size, to retain ownership of their calves. Custom feedlots provide expert feed ration decisions as well as dependable health care.

Custom feedlots charge a fee for all inputs plus a fixed per day fee (yardage). Custom feedlots also charge a fee for bedding, processing and veterinary services. Cattle can also be placed in a custom feedlot on a guaranteed rate of gain basis. This has not been examined in this study.

Custom feedlots have been used extensively in studies such as this. The most recent studies are Unterschultz (1991) and Freeze, et al. (1990). Custom feedlots provide the cow-calf operator an opportunity to feed cattle without having the high fixed costs of investing in their own feedlot. Assuming that the calves are placed in custom lots simplifies the analysis. The yardage cost represents the feedlot's investment in capital assets as well as some level of profit to the owner of the feedlot. The risk of feeding cattle should not be affected by this assumption.

CHAPTER 3 LITERATURE REVIEW

This chapter reviews the literature on retained ownership of beef cattle and the approaches that can be employed to estimate the profitability and risk. It outlines the directions and basis for the approach adhered to in this report. The purpose of this report is to estimate the profitability and risk of retained ownership of beef calves past weaning. The retained ownership problem can be approached by employing several different approaches, such as dynamic or stochastic programming, historical simulation, or option values. The concept of an option value and historical simulation are presented in the sections 3.1 and 3.2. respectively. The option value approach is completed in chapter 4. In addition an historical simulation is completed and presented in chapters 5 and 6.

Several previous studies have indicated that retention of calves past weaning has been more profitable than selling the calves at weaning, including Watt, Little and Petry (1987), Cattle-Fax (1992) and Whitson, Barry and Lacewell (1976). Watt, Little and Petry (1987) found that retaining ownership in a custom lot provided the cow-calf producer with the highest return on average. Cattle-Fax (1992) indicated that retained calves should be held until slaughter weight to achieve the highest returns. Whitson, Barry, and Lacewell (1976) used a multi-period quadratic program to model a typical ranch in the rolling plains of Texas. They found that in some instances retained ownership and custom feeding could increase income and reduce

price risk. Vertical integration can be used to reduce the risk to the cow-calf producer.

The methods used to estimate the profitability of retained ownership, and other similar questions, has been wide ranging. Schroeder and Featherstone (1990), Mjelde, et al. (1991), and Nixon and Mjelde (1992) employed dynamic programming techniques. Unterschultz (1991), Watt, et al. (1987), Cattle-Fax (1992) and Carter and Loyns (1985) employed an historical simulation. In these studies, the production costs and returns are simulated over the study period. Carter and Loyns (1985) employed actual production costs and returns from western Canadian feedlots and added an historical hedging simulation, while the other employed historical production cost data.

3.1 Option Value

The first method employed in this analysis is the concept of an option value. Option values are defined by Fisher and Hanemann (1989) in the following manner:

> "... whenever a decision has the characteristics that one of the possible outcomes is irreversible, and there is some prospect of gaining better information about future benefits and costs of these outcomes, a kind of extra benefit attaches to the reversible outcome. This extra benefit is known as option value ..."[9]

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[9] Fisher A.C. and W.H. Hanemann, Option Value: Theory and Measurement, Working Paper No. 503, Department of Agricultural and Resource Economics, University of California, May 1989, pp 1.

The theory of option value was originally developed as a measurement of the value of a public good. The theory was later expanded to include individual firm investment strategies. Henry (1974), Arrow & Fisher (1974), Fisher & Hanemann (1989), Abel (1983), Fisher & Hanemann (1987), and Freeman (1985) all deal with option valuation of the loss of a public good. Arrow & Fisher (1974) show one possible method of calculating option values assuming the public is risk averse. A two period model is presented to demonstrate the technique. The findings indicate that a risk averse individual when faced with an irreversible decision will have a positive option value. Fisher & Hanemann (1987) show option values can be applied regardless of whether the individual is risk averse, risk neutral or risk loving.

The option value concept was applied to investment theory in the early 1980s. Roberts & Weitzman (1981) examined projects that were completed over time. As time progressed, the firm became more certain about the value of the final product. They found it might pay to invest early in projects that appear to have a net present value less that the cost of production. As more information becomes available the firm can continue or discontinue the research. They concluded that the use of a net present value for such projects might be incorrect. Cukierman (1980) and Bernanke (1983) examine projects that involve a one time expenditure. Given that the investment is irreversible and the firm can choose only a portion of the available projects, both look at incentives to postpone expenditures. They both show that the greater the uncertainty over the decision period the greater the incentive (or option

value) to postpone the investment. Both models are used to explain aggregate investment spending over time, and the cyclical nature thereof.

McDonald & Siegel (1986) approach option values from a slightly different perspective. They view investment over time not as way to acquire information but as the payoff from completing the project. They view the market value of the project as varying stochastically over time, which varies independently from period to period such that the future value is never known. They consider the investment decision similar to that of exercising a call option. Majd & Pindyck (1987) combine both the investment over time with the payoff from completing the project. They assume that the market value of the factory is lognormally distributed. They found that "the effects of time to build are greatest when uncertainty is greatest, when the opportunity cost of delay is greatest, and when the maximum rate of construction is lowest". The examples given show that many projects should be undertaken only if the net present value is double the direct costs.

Pindyck (1988) examined how large a factory should be built and when to expand based on option valuation. He assumed that investment was infinitely divisible and that demand varied stochastically then concentrated on finding the marginal investment decision. It was found that "operating options" (investment options) were more valuable the more volatile the demand. He also found that much of a firm's market value is attributable to the investment options that it holds.

Pindyck (1991) developed an example to invest in a widget factory under uncertainty (reviewed later in this report). He then showed how a risk free portfolio could be created using the futures market, and estimated the option value. He later developed a more complicated option pricing method where the value of the project evolves according to a geometric Brownian motion. Dixit (1992) developed a similar example to Pindyck except the case was for aggregate investment as opposed to a single firm investment.

Pindyck (1991) outlines why the traditional method of valuing an investment may be incorrect. If this is the case then the option value approach should be applied to all investment strategies including the retained ownership of beef calves. No previous studies were found that applied option values or quasi option values to the agriculture sector. The methodology is developed in detail in chapter 4.

3.2 Historical Simulation

A common method used to study marketing strategies under uncertainty has been historical simulation. It was employed by Unterschultz (1991) and Carter and Loyns (1985) in Canadian studies. In these studies the revenues and costs are calculated using historical data to provide an estimate of profit or percentage return that would have been achieved. This allows the researcher, for example, to change management styles or marketing strategies, and compare results. This study includes

an historical simulation for the 1979 to 1991 calf crops. In addition to calculating the returns as if the producer bought and sold in the cash market and employed no risk management strategies, hedging on the futures market is included as a marketing tool.

The methods used within the historical simulation are presented in sections 3.2.1 to 3.2.4.

3.2.1 Price Determination

To estimate the returns and costs from retained ownership, the prices received or expended in each period for each weight class must be estimated.

The price quoted in the local paper for cattle is generally an average for the previous day or week. Price is determined by the interaction of supply and demand. The quantity supplied is important as well as the quality. The degree to which the price reflects the individual characteristics of the animal must be addressed. There are many studies completed in the United States that address this question. Buccola (1980), Schroeder, et al. (1988), Faminow and Gum (1986), and Schultz and Marsh (1985) are a few of many. Age, weight, breed, sex, lotsize, seasonality, prices of meat and by-products, and input costs have been identified as characteristics that affect the price of feeder cattle. All of the above, with the exception of Shultz and Marsh

(1985) used data obtained directly from auction markets. These data included the above variables about the characteristics of the cattle. Shultz and Marsh used USDA data, and were mainly concern with heifer and steer differentials. This study is concerned only with steers calves therefore the differentials between steer and heifer calves was not addressed. Similar studies have not been completed in Canada. The characteristics data necessary were not available for use in this study, however the relationship between weight and price is addressed. An econometric model is developed to explain the effects that weight has on the price of cattle. It is again recognized that this is not a complete analysis as many of the factors previously estimated to affect price are not included.

3.2.2 Risk

The literature on risk is extensive. The cattle owner in this study is considered to maximize his or her expected utility. The utility is derived from the profits of retained ownership of the cattle. The modern expected utility model (EUM) was developed by Von Neumann and Morgenstern in 1947 (see Barry, Risk Management in Agriculture. 1984). The basic idea is that utility is derived from an outcome. For every possible outcome there exists an associated level of utility.

The risk premium is defined as the amount someone would be willing to pay to move from an expected to a certain profit. The shape of the expected utility curve

indicates, for each individual, that individual's attitude toward risk. If it is linear the individual is risk neutral and is only concerns with the level of profits. Risk loving individuals prefer more risk to less. A risk averse individual prefers less risk to more. The Canadian producers lobbied the provincial and federal governments to introduce a program to alleviate the variability of returns to cattle feeding. This lobbying resulted in the introduction of the NTSP. It is therefore considered that Canadian producers, on average, are risk averse and this study will concentrate on the producer who is averse. For a risk averse individual, expected utility is concave. If an individual's expected utility function is known then a best level of income and risk can be chosen. Since expected utility varies across individuals and are seldom known to researchers, this study assumes no specific utility function.

Risk can be measured in a number of ways. Mean square error and standard deviation are similar in that both are a sum of squared error calculation. The main difference is that MSE is measured as the error from a prediction, whereas standard deviation is an error from an average. In addition to these two measures, an alternative risk measure is introduced in section 6.5.4.3. Caldwell, et al. (1982) used historical standard deviations of net revenue as a measure of risk. Coles (1989), Freeze (1990) and Unterschultz (1991) used Mean Square Error and Root Mean Square Error (RMSE).

One way to analyze the results is to classify outcomes into two categories. The method used in this study is known as the mean variance (E-V) efficiency criterion[10]. Using this criterion assumes that the operator is risk averse. In addition, it is assumed that either returns are normally distributed or that the producer's utility function is quadratic in profits. If these assumptions are imposed this criterion is identical to second degree stochastic dominance (SSD) defined below.

Outcomes are classified under SSD in the following manner. Outcome A (with profit P_a and Risk R_a) is preferred to outcome B (with profit P_b and Risk R_b), if $P_a \geq P_b$ and $R_a \leq R_b$ and at least one of the inequalities is strict.

The estimated outcomes are then divided into categories. Category 1 could contain those strategies that have at least one regime that is strictly preferred to it, ie. are dominated, and category 2 contains those outcomes that dominate. This method does not always pick a "best" model. It does give some indication of the relative ranking of the models. Without making additional assumptions about the utility functions of the individual producers, no further results can be obtained using this criterion. The idea is to reduce the total number of outcomes into an efficient set from which the decision maker can more easily choose.

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10 There are various efficiency criteria that can be employed. These are explained in Barry P.J., Risk Management in Agriculture, 1984. Iowa State University.

3.2.2 Hedging

The futures market(s) have provided producers with opportunities to market cattle and other commodities. Many studies have been completed to estimate the returns and risk from using the futures market(s).

Carter and Loyns (1985) employed data provided by Western Canadian feedlots. Using this information they explored different marketing strategies that could be employed in Western Canada. They looked at four marketing regimes. The first was a routine insurance hedge or classic hedge. The second is a "naive selective" hedge, where the producer was looking for $0.05 to $0.10 dollars per pound above break even at the time of placement, if the futures market offers this amount a hedge is placed at the time the cattle are placed on feed, if not the producer remains in the cash market. The third is similar to the second except the third allowed the operator to hedge after the cattle had been placed. The last was a "threshold strategy" in which the cattle were not placed if the futures market offered less than $0.05 to $0.10 per pound over break even. Scenarios also included exchange rate risk. The scenarios were compared by mean and standard deviation of returns. This was completed for both steer and heifer calves. Their findings indicated that a routine hedge reduced profits substantially and in the cases of heifers increased the level of risk. They conclude that for a Canadian producer the basis risk is often greater than the cash price risk, and therefore hedging cattle on the Chicago Mercantile Exchange

was not a viable alternative for Canadian producers. Freeze, et al. (1990) employed a variety of hedging programs and production regimes. The hedging alternatives included a routine hedge, selective hedge (based on a predicted profit of $50.00/per head) and complex hedges where a Canadian dollar hedge was also included. Freeze, et al. found that hedging can be used as a risk management tool for Alberta producers, and that the complex hedge over the study period was considered superior. The main reason cited for this was the declining value of the Canadian dollar through the study period.

Both of the above studies employed a profit per head as their criterion for hedging. This method does not account for the variability of the opportunity cost of capital over the study period. In contrast, this study allows the target profit level to fluctuate as the interest cost fluctuates. The selective hedges are placed based on a percentage return above the real prime interest rate.

Kenyon and Clay (1987) studied profit margin hedging strategies for hog producers. They hedged from one commodity (live hogs) to three commodities (live hogs, corn and soybean meal) and compared these results to remaining in the cash market. They followed the futures and cash market(s) from breeding to finish and found that by using varying hedging strategies the producer could improve returns and decrease risk. The best hedging opportunities occurred during the period 2 quarters prior to the hogs reaching market weight. Maximum margin account draw

down and costs of hedging were also examined. The study showed that the margin calls could be large as some were 3 - 5 times as large as the original margin required. The real cost of margin, as well as the maximum, minimum and average margin required to service the hedged position is addressed in this study.

If the futures market(s) are to be used in a hedging program then their ability to predict future cash prices must be addressed. If the producer is not going to deliver against a futures contract then one option is to sell in the cash market. If the futures market is a poor predictor of cash price, then the effectiveness of the hedging program is lost. Numerous studies have addressed this topic and most conclude that the futures price for live cattle is a poor predictor of cash price for horizons greater than 6 months.

Koontz, et al. (1992) provides some of the more recent work, using seemingly unrelated regression models of variable feed costs on futures price, from 1 to 12 months prior to delivery. They concluded that the live cattle futures contract price reflected the average variable costs of production, until the cattle were placed on feed. When the cattle where placed on feed (4-6 mouths prior to slaughter) supply and demand conditions dictated the futures price. The reason cited for this is that the cattle production can be shifted from one finishing period to another when the futures contract is say 12 months from delivery. If the futures market for live cattle offered larger profit for the October contract versus the December contract, cattle

production would be shifted to the October market. This supply shift causes the October market to fall and the December market to rise. This supply response insures that there are not large profits to be made by shifting supply. Once the cattle have been placed on feed (less than five months from delivery) the local supply and demand conditions prevail.

The implication for hedging is that the producer is unlikely to see large profits in the futures markets prior to the five months from delivery. The swings in price will likely occur after the supply has been established.

CHAPTER 4 OPTION VALUES

Retained ownership of beef calves can be treated as an investment decision similar to those discussed in section 3.1. In this regard the option of concern is the option to retain ownership. This chapter describes the theory of an option value as well as provides examples of how this can be applied to investment and disinvestment decisions. An example of how this may be applied to the retained ownership question is included in section 4.3.3.

Suppose a government is considering developing some land. This land is currently forested. If the development was to proceed the option to have a forest would be lost. If, on the other hand, the development was delayed the option to have either a forest or the development remains available. The option to have either the forest or the development may have some value. This is the concept behind option values or option valuation.

Although the example above is simple, it illustrates one of the conditions that must be met before an option would have value. This is the idea of irreversibility. If the development decision could be reversed then there would be no loss of the option. In the above example, it is easy to see that if the development was completed, the forest would be lost forever. This then represents an irreversible decision.

4.1 Investment and Disinvestment

At the firm level, a similar sort of option may occur. If this is the case then it is important to try and estimate the value of this option. The firm, for instance, could have a limited development budget. Once that development budget is spent, the option to invest in further projects is lost. If, in another case, the firm decides to sell one of it's enterprises, the option of owning that enterprise has been lost, at least in the short run.

The traditional way to view an investment is to estimate the future proceeds from an investment and then discount those proceeds to present value terms. If the discounted proceeds are greater than the cost of the investment, the investment is made. This has been traditionally taught as the net present value of an investment decision. This involves projecting the costs and benefits over the life of the project and discounting them to present value. The project with the largest net present value (NPV) or the highest internal rate of return (IRR) is then chosen[11].

What has been traditionally missing from this NPV calculation is the value of the lost option, if any. The traditional NPV method may be incorrect when the decision is not reversible and should be adjusted to reflect the cost of the lost option. The option in this case is the option to invest in future projects.

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11 This assumes that the magnitude of the investment is similar. If this was not true, choosing the project with the highest IRR may be incorrect.

An investment option value can be thought of as being similar to a financial call option. The holder of a call option has the right but not the obligation to buy an asset at an agreed price (exercise or strike price). The cost of this option is the option price. Once the option is exercised the option no longer exists. This would be similar to many investment decisions where the firm has a limited amount of capital available for investment. Once this capital is invested, the option to invest is lost, or alternatively the firm has exercised it's investment option. The options that each firm has available would depend upon the expertise or management skills of the firm itself.

Pindyck (1991) mentions that investment decisions in the past have been poorly understood and cited the inability to predict the future investment decisions of businesses using econometric models. The idea that, with each investment decision there is an associated option value may in part explain this poor understanding.

A disinvestment decision can be thought of in a similar manner. The financial option market analogue would be a put option (option to sell). In this case the option lost is the option to sell the item in question at a later date. The traditional method of making this decision would be to estimate the net present value of the asset and compare this to the market value. If the market value is greater than the discounted net income stream the development would be sold. Again this may be incorrect if there exists an option value associated with the sale.

4.2 Irreversible, Postponable, and Uncertain

Pindyck (1991) outlined three elements of an investment decision that must be present if an option is to have value. They are, the investment must be irreversible, postponable and uncertain. These are discussed in detail below.

If the investment decision is completely reversible then there exists no option value because the option is not lost when the decision is made. If, for example, the firm could build a factory and if it could later costlessly sell that factory then it could enter and exit the enterprise at will. If the firm can enter and exit costlessly then no option is lost.

How is it possible to consider an investment decision irreversible if the investment could be sold to a competing firm? One possibility may be the degree to which the costs are unrecoverable or sunk. If some of the investment costs were in industry specific items, the resale value of these items may be considerably less than the purchase price. The difference between the purchase and resale value is considered a sunk cost. If the output price falls after the investment is made, the market value of the investment will decrease accordingly. The investment may then be irreversible in the ability to recover the original investment.

A second condition for an option to have value is that the investment decision can be postponed. If the decision is not postponable then a firm has no lost option. For example, if, because of zoning restrictions, a firm had to develop this year or forfeit the right to develop and decides not to build, no option is lost. An extension of this example may be in a competitive market place. It may not be possible for a firm to delay the decision, since other firms will enter and exploit the market opportunity.

The third condition is that the future is uncertain. If the future was certain then the correct decision would be made each time, and would not change as prices changed. If the relative costs and benefits did not change no option value would exist. If all future market and production information is known with certainty then waiting till further information was available would not be necessary.

4.3 Examples

To show how option values for various decisions could be calculated a few examples are given below. Each example is followed by a discussion of whether it is irreversible, postponable and/or uncertain.

4.3.1 Investment Decision

Following Pindyck (1991), suppose a firm is considering building a factory to produce widgets. The only cost to produce widgets is the cost of the factory. This means that there are no variable costs associated with the production of widgets. At the present time the cost to build the factory is $800.00, the widget sell for $100.00 per widget and the interest rate is 10% per annum. The factory itself is expected to last forever and produce one widget per year. When the investment decision is made, the factory is constructed and a widget is produced in the first year.

Assume further that the price of widgets is uncertain and changes at the end of year one. There is fifty percent chance that the price will fall to $50.00 per widget and a fifty percent chance that the price will rise to $150.00. After the price change at the end of year one the price will remain constant at the new level forever. There is no one else currently producing widgets and the firm in question is the only firm with the technology to produce widgets. This would insure that the investment is postponable.

The traditional method of viewing this would be through the use of the net present value. The expected price of the widget is $100.00 per widget for the first year and 0.5 * (50 + 150) or $100 per widget in following years. The expected net present value (NPV) in this example is as follows:

$$(1)\quad NPV = -800 + \sum_{t=0}^{\infty} \frac{100}{(1.1)^t} = -800 + 100 + \sum_{t=1}^{\infty} \frac{100}{(1.1)^t} = -800 + 1100$$

$$(2)\quad NPV = \$300.00$$

Given that the net present value is positive the investment would be made. This decision is incorrect if we consider the value of the lost option. Suppose that instead of investing in the factory today the firm delayed the decision for one year until better price information was available. The firm is, of course, foregoing the profits of producing the widget in the first year. As discussed earlier the price of widgets will change to either \$50 or \$150 with an equal chance. Define scenario 1 as the case where the price falls to \$50. If the price were to fall to \$50 the present value, one year from today, of this income stream is \$550 ($\sum_{t=0}^{\infty} 50/(1.1)^t$). The cost to build the factory is still \$800 therefore the firm would not build. Under scenario #2, with the price rising to \$150, the present value of the income stream is \$1650 ($\sum_{t=0}^{\infty} 150/(1.1)^t$). The factory would still cost \$800 to build and would, therefore, be constructed. We can now convert this choice decision to present value terms.

If scenario 1 occurs the firm will not enter the widget business at all therefore the present value of this decision is \$0. If scenario 2 occurs the firm will construct the factory one year from today and begin production. The net present value of this option is shown in following equations:

$$(3) \qquad NPV = 0.5 * (0) + 0.5 * \frac{(-800 + 1650)}{(1.1)}$$

$$(4) \qquad NPV = \$386.00$$

One can see that the correct decision for the firm to make under these artificial conditions is to wait for one year to make the investment decision. This occurs even though the revenues for the first year are lost while the decision was postponed. If the price did not increase by $50.00 per widget but instead increased by something less than that, there would become a point where the lost revenue from the first year would outweigh the value of waiting for further information to arrive. Given that the price rises or falls by $50 with a probability of 0.5, one can calculate the price of the option value as the difference in the two net present value calculations or $386 - $300 = $86.00.

Implicit in the preceding example is the assumption that the factory will cost the same amount to build one year from today. This assumption is more plausible if we assume that values are given in real terms rather than nominal terms. The example brings out the important features which underlie the existence of option values. The investment decision was irreversible in that the sunk costs would be high if the widget price was to decline. The investment was also postponable and prices in the future are uncertain. This simple example can be expanded to include the case where the price of the widgets follows a random walk (see Pindyck, 1991).

4.3.2 Disinvestment Decision

In this example we will examine essentially the same problem except we will consider this from a point of view of closing the factory rather than constructing or buying it. Assume the production of widgets and the price structure is the same as in the previous example. The current scrap value of the factory is $1200.00. In the traditional method of making this decision would again be done using the net present value. If the future discounted returns from the production of the factory are less than the current selling price the factory would be sold. Calculating the net present value of this decision:

$$(5) \qquad NPV = 1200 - \sum_{t=0}^{\infty} \frac{100}{(1.1)^t}$$

$$(6) \qquad NPV = \$100.00$$

The net present value from the above is then $100 and factory would be scrapped. If, on the other hand, the firm waited for one year before the decision, the factory will have produced 1 widget and sold it for $100.

Scenario 1 is again defined as if in one year the widget price falls to $50. At this time the firm would again have the decision to keep or close the factory. The present value at year one would be $550.00 from this income stream and the factory could be sold for $1200.00. The firm would therefore sell the factory for $1200 at the end of the first year.

Under scenario 2, with the price now at $150 per widget, the present value of the income stream is $1650 and the factory would not be sold. Now if we again convert all of this to today's values as follows:

$$(7) \qquad NPV = [100 + (0.5 * \frac{1200}{1.1}) + (0.5 * \frac{1650}{1.1})] - 1200$$

$$(8) \qquad NPV = \$195.45$$

The option value in this example would then be the difference in the two net present values of $195.45 - $100.00 = $95.45. This example again shows that the traditional method of viewing a project may not be the correct method, if the decision is irreversible, postponable and uncertain.

In the above example, an assumption was made that the firm could sell the factory for $1200 as scrap value. In some disinvestment decisions the factory would not be scrap but instead would have a market value as a going concern. If the factory could be sold to competing firm at a price greater than scrap value, then presumably the firm purchasing the factory would adjust their bid price as the price of widgets changed. The question then becomes how quickly does the market value of the factory change in response to an output price change, and does it change to the level it "should" using the net present value method.

4.3.3 Retained Ownership of Beef Calves

Retained ownership studies have traditionally been completed by discounting the revenues and costs of feeding the calves to a net present value. The present value is then compared to selling the calves in the fall. This approach is incorrect if the cow-calf producer is losing an option to retain ownership. The following example applies the theory of an option value to the retained ownership question.

The option value calculated is the option to retain ownership and feed the cattle past weaning. Does the cattle market meet the conditions of irreversibility, postponability, and uncertainty? It is easy to see that the cattle market is uncertain and that future returns from feeding are difficult to predict. The decision to sell fall calves for many farms could be postponed to gather further market evidence. On an individual farm basis this would depend, in part, on the cashflow requirements and the capital structure of the farm. We will assume that the farmer in this example has sufficient means to postpone the decision. Feeder cattle are considered non-storable since the cattle would have to be fed by someone and therefore the market would not be affected if the farmer decided to feed the cattle or sell them. The concept of irreversibility is more difficult to approach. It can be said that cattle are almost a homogenous product, and that the cattle market is close to perfectly competitive. One of the requirements of perfect competition is free entry and exit. If entry and exit is costless then this decision would be reversible. We could however look to the transaction costs to provide some measure of irreversibility. It is assumed that the

seller would have to haul the calves to the local market to be sold. The costs involved with this are shrinkage, commission, deathloss and hauling. If the next day the same farmer was to repurchase similar cattle hauling costs would again be applicable. The extent to which these costs (sunk) provide a measure of irreversibility is difficult to say.

A theoretical market is examined to determine the industry structure that may be required in order to generate an option value. An example of a two period backgrounding operation is explored.

An econometric model was estimated to explain some of the questions about the structure of the cattle industry and the factors which explain feeder cattle prices. The econometric equation developed was in a log-log form with feeder price as the dependent variable[12]. The estimated model suggests that the weight of the feeder cattle affects the price in a negative direction. Therefore as the size of the animal increases the price per pound decreases. The coefficient of logged weight is -0.08496. Slaughter price was used as a variable as well. The coefficient of logged slaughter price is estimated to be 0.29136. This shows that the slaughter price of cattle and feeder price increase and decrease together. Using this information and average prices for various weight classes a price for any weight can be generated. The following feed costs and prices are then simulated for the period October 1990 to

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12 The estimated model is included in Appendix C and data sources are included in Chapter 5.

December 1990. It is assumed that 550 pound calves are weaned and ready for sale on October 31, 1990. Suppose we are planning to sell the cattle today (October 31), the other option would be to feed the cattle through to December and sell them at the end of December. We will assume that the cattle would gain 2.0 lbs/day on average. The cattle will weigh 610 and 672 pounds at the end of November and December, respectively. The traditional way to view this would be to estimate the profits that could be made by feeding the cattle and compare those results with selling today. If the profits from feeding are positive then the cattle will be fed. We assume a death loss of 0.25% per month.

Variable Costs:

October	$0.96 per head per day.

Prices & Weights

October 31	550 lbs	$100.9/cwt
October 31	610 lbs	$100.5/cwt
October 31	672 lbs	$ 99.7/cwt
October 31	1050 lbs	$ 86.6/cwt

Treasury Bills

October	12.0 % or 0.94887% per month

Option 1 Sell today
Total Revenue price x weight = 100.9 x 550/100 = $554.95

Option 2 Feed to December	
Total Revenue discounted to October[13]	
($99.7/cwt x 6.72 cwt x 0.995)/(1.0094887) ^ 2 =	$654.16
less Variable costs $0.96 per day x 61 days =	$ 58.56
less Cattle costs	$554.95
Profit/(loss)	$ 40.65

Given the above scenario cattle would be fed to December. Now lets suppose that the price of slaughter cattle was to change, on November 30. It could go up or down by $3.00/cwt with an equal chance of either occurring. This would mean that the slaughter price will change to $89.6 or $83.6/cwt with an equal chance. One could now predict what will happen to feeder prices if the slaughter price was to change.

672lb price = exp (ln(99.7)+(0.29136 *(ln(89.6) - ln (86.6))
= $100.7

or

672lb price = exp (ln(99.7)+(0.29136 *(ln(83.6) - ln (86.6))
= $98.6

610lb price = exp (ln(100.5)+(0.29136 *(ln(89.6) -ln (86.6))
= $101.5

or

610lb price = exp (ln(100.5)+(0.29136 *(ln(83.6) -ln (86.6))
= $99.5

If we were now at the end of November and deciding whether to feed to December or not, then we could again look at the profitability of this decision. If the slaughter price had increased to $89.6 our decision would look as follows:

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13 0.995 reflects the death loss over the two months.

Revenue from selling discounted to November.	
Total Revenue discounted to November	
(($100.7/cwt x 6.72 cwt x 0.995)/1.0094877) =	$666.99
Feed Costs = 31 days * 0.96/day =	$29.76
Cattle costs = ($101.5/cwt * 6.10 cwt * 0.9975)=	$617.60
Profit per head	$19.63

If the slaughter price had decreased to $83.6 our decision would look as follows:

Revenue from selling discounted to november.	
Total revenue discounted to November	
(($98.6/cwt x 6.72 cwt x 0.995)/1.0094877) =	$653.08
Feed Costs = 31 days * 0.96/day =	$29.76
Cattle costs = ($99.5/cwt * 6.10 cwt * 0.9975)=	$605.43
Profit per head	$17.89

In both of the above cases, the decision would be to feed the calves until December regardless of what happened to the slaughter price. Given this there would be no option value generated or it is zero. This is not to say that the actual profits from feeding would be positive just the projected profits for the next month are positive. The profit over the entire feeding period will vary as the slaughter price changes.

4.4 Conclusion

In all of the examples attempted the option value for cattle feeding was either zero or very small. This would be what is expected as the commercial cattle market is best described as perfectly competitive. Also this may imply that the cattle market quickly adjusts to new price information. In the first two examples the price or

market value of the factory was assumed to remain constant throughout the example. With the cattle market this of course is not the case. As the output price (slaughter price) changes the value the calves (factory) changes as well. As the price of slaughter cattle changes, the feeder cattle prices change accordingly. There does not appear to be a large enough lag to generate an option value. If this example was expanded to include actual data likely the option values would be zero or very small. The first structural component seems to be the amount of time the industry requires to adjust to a price change. If the slaughter price of cattle was to change, how long does it take for the change in price to affect the feeder cattle market? If this adjustment is instantaneous then no option values will be generated. The size of the change in price seems to have a large effect on the outcome as well. The larger the change the better chance there is that an option value will be generated. A final consideration was given to mathematical functions which could be employed to describe the characteristics of the demand curve. The characteristic of concern was weight versus price, or as weight increases how much does price decrease.

CHAPTER 5 DATA SOURCES

This chapter describes the sources of data used in this study. Data collected includes: 1) slaughter cattle and feeder cattle prices for various weight groups, 2) Chicago's live cattle futures price and feeder cattle futures price, 3) local barley price 4) treasury bill rate, and 5) exchange rate. In addition, consideration was given to CBOP and NTSP programs (sections 2.2.1 and 2.2.2) introduced during the period in which the data were collected. Monthly data for the period January 1979 through December 1991 (13 years) were collected.

5.1 Feeder Cattle and Slaughter Cattle Prices

Data were collected for quality four to five hundred, five to six hundred, six to seven hundred, and eight hundred plus pound feeders steers in the Edmonton region (dollars per hundred weight, $cwt) and direct slaughter price for Edmonton. The data source for all cattle prices was Alberta Agriculture, Economic Services Division. Alberta Agriculture indicated that these prices were obtained from CANFAX. Weekly prices can also be obtained from Agriculture Canada's, Canada Livestock and Meat Trade Report.

The feeder prices are averages reported for the Edmonton area auction markets and were quoted for the third week of every month. These cattle represent

average cattle available in the particular time period. It should be noted that in some time periods very few cattle of one weight group were sold. It is assumed that the cow-calf operator produces average cattle and calves.

Slaughter prices are of live weight cattle sold directly to Alberta processing plants. It includes all grade A cattle. It is assumed in those years when the calves are kept until slaughter, that they would grade A with average proportions of grade A1, A2, A3, and A4. The direct slaughter price reflects the variance in the cattle received by the packing plants. If the producer is superior or inferior to average then an adjustment would have to be made.

5.2 Live Cattle Futures Prices

Daily data were obtained for all contracts available each day for the live cattle futures contract traded on the Chicago Mercantile Exchange (CME). These data were purchased from TICK DATA INC. 720 Kipling street, Suite 115, Lakewood, Colorado, 80215. This data is also available in The Wall Street Journal and Chicago Mercantile Exchange Yearbook.

The specific contracts used are the June, August, October and December live cattle futures contracts. There are also contracts available for the months of February and April, however none of the production regimes outlined in chapter six

finish during these months, and therefore are not required for this study. In addition the Chicago Mercantile Exchange offered contracts in January for three years and in September for one year during the study period. These contracts have not been included in this analysis.

5.3 Local Feed Prices

Feed price indicates the costs to bring feeder cattle to slaughter weight.

5.3.1 Barley Prices

Barley represents a major feed used in Alberta. Red Deer street price of barley, in dollars per tonne, is selected.[14] The source of data is Alberta Agriculture's Statistical Yearbook (various).

5.3.2 Cereal Silage Prices

Cereal silage is also used in the production of cattle in Alberta. Some producers use hay or haylage or combinations of the above with straw. For the purposes of the report it is assume that the rations fed will include cereal silage as

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14 The barley prices have been adjusted to reflect the Crow Benefit Offset Program, see section 2.2.1.

the roughage in the ration. After speaking to feedlot operators in southern Alberta and agricultural professionals the following formula is chosen to estimate the price of cereal silage[15]. This formula is based on the feedlot's bill out rate or the price the customer would be charged.

(9) $$Prsil = 12.5 * prbar * 0.021772$$

Where:
prsil is the per tonne price of silage
prbar is the per tonne price of barley
0.021772 is used to convert the price of barley per tonne; to price per bushel (1/2204.622*48).

The basic formula then is 12.5 times the per bushel price of barley. The feedlot manager indicated that the formula has been 12 times in the past but thought that the 12.5 would be a good indication of price over the study period.

5.4 Treasury Bill Rate

The Treasury bill rate used is the Bank of Canada rate for 90 day T-bills (%). The closing rate of the third Wednesday of every month is used. The T-bill rate is considered a safe investment rate. The source of the Treasury bill rate is the Bank of Canada Review (various issues).

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15 This information was given to the writer in confidence. As such the direct source is not quoted.

5.5 Exchange Rate

Exchange rate data, quoted as Canadian dollars required to buy one U.S. dollar, were collected for the third Wednesday of every month. The exchange rates were used to convert the Chicago futures price to nominal Canadian dollars and were obtained from Alberta Agriculture, Economic Services Division.

5.6 Consumer Price Index

The Consumer Price Index (CPI) for all goods (1986=100) are used to convert the costs and returns to constant dollars and were collected monthly for the week containing the third Wednesday of every month. Source of data is the Bank of Canada Review (various issues).

5.7 Indexes

Full or complete times series data were not available for all of the required data. In these cases, a time series was developed using price indexes. Not all of the indexes shown below are provided monthly. In some case these indexes are calculated on a quarterly basis. If this was the case, the first quarter index was assumed to represent the index for the first three months, etc. The indexes used were obtained from Cansim and are shown below along with their cansim matrix numbers:

1. Veterinary Services - Western Canada D605827;
2. Supplies and Services - Western Canada D605834;
3. Prepared feed - Western Canada D605663;
4. Farm Inputs - Total Western Canada D605002;
5. Prime Business Loan Rate - Typical B113855;
6. Bank of Canada Rate (as at Thursday) B113844.

CHAPTER 6 METHODOLOGY AND RESULTS

The simulation completed in this report is discussed in this section. It is assumed that the cow-calf operator produces 100 steer calves every October. These calves can then be sold or fed to a heavier weight. It is assumed that the calves are placed in a custom feedlot following different feeding regimes until slaughter weight is achieved. Any profits or losses attributed to feeding the calves are calculated at the end of each month.

Section 6.1 contains a discussion of the six different feeding regimes to be followed by the feedlot. Section 6.2 describes the feeder cattle pricing relationship used in this simulation. The major emphasis is this section is the development of an adjustment to price for different cattle weights.

Section 6.3 presents the methodology for calculating costs, revenues and returns for the first portion of the simulation, where it is assumed that the producer remains in the cash market. Section 6.4 contains the results from the first part of the simulation.

Section 6.5 contains the second portion of the simulation, a comparison of alternative marketing strategies that can be employed to reduce risk and/or increase returns.

The final section, 6.6, presents results obtained from the second part of the simulation. The risks and returns under each of the marketing alternatives, the length of time needed to place hedges, and the level of margin required to service the hedged position are examined.

6.1 Feeding Regimes

Three weight classes of steer calves (four hundred and fifty, five hundred and fifty, and six hundred and fifty pounds) are chosen to represent potential weaning weights for an Alberta producer. The four hundred and fifty pound weaning weight is included to represent those producers calving later in the season or having smaller cows. The six hundred and fifty pound weaning weight represents the earlier calves and larger cows. The size of the calves at weaning is an important determinant of a feeding regime. For the most part the heavier the weaning weight the less marketing flexibility afforded the owner. There are various feeding regimes explored in the simulation model. A summary of each of these is shown in table 2. The weight gains and final weights are shown prior to shrinkage.

Table 2
Summary of Feeding Regimes
Weight Gains are shown as lbs/day prior to shrink

Month	450a	450b	450c	450d	550a	650a
Initial Weight	450	450	450	450	550	650
November	1.5	1.25	1.25	2.0	2.0	2.0
December	1.5	1.25	1.25	2.0	2.0	2.0
January	1.5	1.25	1.25	2.0	2.0	2.0
February	1.5	1.25	1.25	2.0	2.0	2.0
March	1.5	1.25	1.25	2.0	2.0	3.2
April	2.0	1.25	1.25	2.0	3.2	3.2
May	2.0	*2.1	2.5	3.2	3.2	3.2
June	2.0	*2.1	2.5	3.2	3.2	---
July	3.2	*2.1	2.5	3.2	---	---
August	3.2	*2.1	3.2	---	---	---
September	3.2	3.2	3.2	---	---	---
October	---	3.2	3.2	---	---	---
November	---	3.2	---	---	---	---
Ending Weight	1153	1224	1201	1106	1143	1188

* denotes pasture

The feeding regimes are chosen to represent production alternatives available to the cattle feeder. The smaller calves (450 pounds) allow the producer more production alternatives than the larger calves. The smaller calves can be pushed to market as in feeding regime 450d or they can be backgrounded as in 450a, 450b and 450c. Within those the calves could be placed on grass during the summer months or remain in the feedlot. These two alternatives are represented by 450b and 450c,

respectively. Weaning weights greater than 500 pounds offer fewer alternatives than the lighter calves, therefore only one alternative is presented for each the 550 and 650 weaning weight. Although the alternatives outlined in table 2 do not included all of the alternatives, they represent common regimes followed by Alberta producers.

The first four feeding regimes begin with a weaning weight of four hundred and fifty pounds. Feeding regime 450d, is the shortest of the four hundred and fifty pound feeding regimes. This indicates that the cattle are grown at a faster rate throughout the feeding period, and production ends in July. Feeding regime 450a exhibits a lower rate of gain, when compared to 450d, during the first months, and production is not completed until September. Feeding regimes 450b and 450c are the longest feeding regimes presented and the cattle reach slaughter in November and October, respectively. In addition these two feeding regimes exhibit the lowest rate of gain over the first months of production. The major difference between 450b and 450c is that the cattle are pastured during the summer months in 450b and remain in the feedlot during the summer months in 450c. The four feeding regimes beginning with a weaning weight of four hundred and fifty pounds show the flexibility that is afforded to the producer. The final two feeding regimes, 550a and 650a, show only one possible feeding regime that could be adhered to for weaning weights of 550 and 650 pounds, respectively. 550a ends production in June while 650a ends in May.

The actual rations employed are included in appendix A. The rations consist of a combination of rolled barley, cereal silage and supplement. It is assumed that the supplement contains the required level of salt and minerals. Salt and minerals could also be provided on an ad libitum or free choice basis, however no additional costs are included to allow for this. The feeding regimes outlined in table 2 represent only a portion of the possible feeding regimes, but are felt to be representative of common feeding regimes in Alberta. Note, the simulation presented does not allow any production risk. Production risk is the risk that calves will not gain at the rate estimated or will not meet deathloss estimates, for example. The production regimes presented are an average that would occur, if followed during the study period, and did not vary from year to year as they would in a farm environment.

6.2 Price Adjustment

The price data collected include four to five hundred, five to six hundred, six to seven hundred and eight hundred plus pound steer calves in the Edmonton region. These prices are assumed to represent the price for a four hundred and fifty, five hundred and fifty, six hundred and fifty, and an eight hundred and fifty pound steer respectively. One problem is how to adjust these prices as the weight of the calves varies during the feeding regimes. A log-log econometric model was developed to indicate how weight affects the price. Independent varibles include weight, Tbill rate, seasonality, slaughter price, and lagged feeder price and is shown in Appendix C.

As expected logged weight of cattle and logged price of cattle are negatively related. The estimated coefficient is -0.08496. The price observed is then adjusted to calf weight for each feeding regime. The regression is estimated using a double log functional form. The only variable of interest is the weight of the animal, since the rest of the variables are unchanged. For example, suppose a price for a 650 pound calf is observed in January 1989. This price already contains seasonality, government programs, and slaughter price information. The only difference in this study is that the calves may weigh 630 or 677 pounds in January. An adjustment to the observed price is made to reflect any difference in weight.

The difference of the log of the observed weight and estimated weight is multiplied by -0.08496. This amount is then added to the log of the observed price. The antilog of this number is taken to arrive at an estimate of price. This can be summarized by the following formula:

(10) $$epr = \exp^{(\ln(obpr) + ((\ln(oblbs) - \ln(elbs)) * -0.08496)}$$

Where:
epr is the estimated price of the feeder
obpr is the observed price of a 450, 550, 650, or 850 pound steer
oblbs is the observed weight of the calves
elbs is the estimated weight of the owned calf

This formula is used to change the observed price to a price that would have been "realised". Below is an example of how much this adjustment changes the "realised price". Given a price of $87.80 per hundred pounds for a 650 pound feeder steer.

Weight	Price
630 lbs	$88.0/cwt ("realised")
650 lbs	$87.8/cwt (observed)
677 lbs	$87.5/cwt ("realised")

Each feeding regime exhibits different weight gains in different months. One potential problem is that the cattle on a higher rate of gain are fleshier than those on a lower rate of gain. The feeder cattle market often discounts fleshier cattle, or those cattle that have been on a higher rate of gain. As only one price "for an average steer" is obtained for each weight class, a potential problem exists. This problem is recognised however no attempt is made to adjust the prices to allow for this discount or premium. There are other characteristics that affect the price of feeder cattle, such as breed, colour, condition, and lotsize. It is assumed that the calves in this study are average.

6.3 Cash Market Simulation

This section presents the calculations of profit per head and real rate of return from retaining ownership of 100 beef steers past weaning. A simulation is completed as if the producer places 100 steer calves in a custom lot in the third week of every October from 1979 to 1991 (13 years). The simulation calculates the profits that would have been achieved had the producer sold the calves at the end of each month. The methodology employed to calculate the monthly costs is presented in section 6.3.1. The calculations, for revenue that would have been generated if the cattle were sold each month is presented in section 6.3.2. Finally the profits per head and percentage returns calculations are shown in section 6.3.3.

6.3.1 Cost Calculation

Feed rations for the calves gaining less than 2.5 pounds per day are adapted from Alberta Agriculture; Beef Herd Management (1989), whereas the rations fed to the calves gaining 3.2 pounds per day are adapted from Coles (1989) and Untershultz (1991)[16]. Full or complete times series data were not available for all of the required data. These include supplement cost, trucking costs, commission cost, veterinary services and yardage. In these cases, a time series was developed using price indexes (see appendix A). The ration for each feeding regime does not change from year to year. This assumption limits the producer from substituting away from a higher priced input, which likely results in simulated returns that are lower than if substitution were possible. This is a limiting assumption since producers would change the rations as the relative prices change[17].

It is assumed that the feed for each month was purchased at the beginning of that month. This assumption may not be appropriate for all feedlots. Many feedlots and producers have a ready supply of cereal silage or haylage located on site for use throughout the year. It is also assumed that the feed could be purchased in the exact

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[16] One other set of rations were used for comparison purposes. These are rations that were used by a southern Alberta feedlot in 1991. Again the rations were given in confidence. The difference in the total feed cost was very small. On average the beginning rations were less expensive and the finishing rations were more expensive. The average cost was not significantly different from that shown in this study.

[17] Many producers in the fall of 1992 and spring of 1993 substituted wheat for barley in at least a portion of their rations.

amount required for the next month and the price of the feed and transportation cost per tonne of feed remains constant regardless of the amount purchased. The costs of participation and non-participation in the National Tripartite Stabilization Program (NTSP) are addressed. It is assumed that the producer files for a rebate under the Crow Benefit Offset Program (CBOP) on a timely basis.

The cost of barley, silage and supplement is first calculated. The per diem ration amount is multiplied by the price. The daily cost of barley, silage and supplement are added together to arrive at a daily feed cost per animal.

$$(11) \quad dayfeedct_{(y,m)} = (amtbar * (baropen + bartran - crowben)) + (amtsil * silpr) + (amtsup * suppr) + (amtbar + amtsil + amtsup)/2204 * proc$$

Where:
dayfeedct is the daily cost of feed for each month
subscript y and m refer to year and month respectively
amtbar is the amount of barley in the daily ration
baropen is the open board barley price
bartran is the transportation cost of barley
crowben is the CBOP payment per tonne of barley
amtsil is the amount of silage in the ration
silpr is the price of cereal silage
amtsup is the amount of supplement in the daily ration
suppr is the supplement price
Proc is the processing cost per tonne of feed

The daily costs are then converted to a monthly total. The death loss rate assumed for each feeding regime is summarized in appendix A. It is assumed that the animals that die each month consume fifty percent of the feed for that month.

The effective lotsize is the amount placed on feed at the start of the month (lotsize) less the deathloss plus one half of the death loss. The per diem feed costs are multiplied by the effective lotsize (adjusted for death loss) and the number of days on feed.

$$(12) \quad mthfdct_{(y,m)} = (1 - death + death * 0.5) * lotsize * days * dayfeedct$$

Where:
mthfdct is the monthly feed costs
death is the expected deathloss during month m (% of total)
lotsize is the number of cattle at the beginning of month m
days is the days in month m
dayfeedct is the daily cost of feed for each month m
0.5 assumes the animals that die consume 50% of feed

In addition to the feed cost the producer must pay custom feedlot charges for each month. These costs consist of yardage, bedding, treatment and processing charges. Yardage and bedding costs are a per animal day rate. The treatment costs are also assumed to be a per animal day cost. The processing cost is for growth implants and vaccinations. The processing costs are a one time cost per animal[18].

$$(13) \quad mthfdlt_{(y,m)} = ((yardage + bedcost + treat) * days * lotsize * (1 - death + death * 0.5)) + proc * lotsize$$

Where:
mthfdlt is the monthly feedlot charges
yardage is the per diem yardage cost
death is the percentage deathloss during month m
proc is the processing charges during month m
bedcost is the per diem cost of bedding
treat is the per diem treatment cost

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[18] Not all months have processing charges. See appendix A.

The total monthly cost is then the monthly feed cost plus the monthly feedlot costs. The simulation is completed as if the producer does and does not participate in NTSP. If the producer participates then the premiums are added to the cost of the first month of feeding[19].

$$(14) \quad monthlycosts_{(y,m)} = mthfdct + mthfdlt + (Ntsp\,prem * lotsize)$$

Where:
monthlycosts is the total monthly costs (nominal dollars)
Ntsp prem is the premium per head

The above costs are in nominal dollars. In order that the costs for each month can be added together the costs must be converted to real terms. The costs are converted back to June 1986 dollars using the Consumer Price Index.

$$(15) \quad realmthct_{(y,m)} = monthlycosts_{(m)} * \frac{CPI_{(June,1986)}}{CPI_{(y,m)}}$$

Where:
realmthct is the discounted monthly costs
CPI is the consumer price index (all goods 1986=100)

The total costs for each month are added together to provide a total cost to date for each feeding regime.

$$(16) \quad totalcosts_{(y)} = \sum_{m=1}^{m=t} realmthct$$

Where:
totalcosts are the total costs for year in 1986 dollars
t is the number of months to date

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[19] The analysis was completed as if the producer belonged to the NTSP program and as if the producer did not belong.

Each month of feeding is from the third week in one month to the third week of the next. When the cost for a particular month is referred to, it is the second of these months. For example the first month of feeding is from the third week in October to the third week in November. The costs incurred during this period are referred to as November's costs. The total cost of feeding the cattle to the third wednesday in December is sum of November and December's monthly costs.

6.3.2 Revenue Calculation

The revenues, as if the calves were sold each month, are estimated and converted to June 1986 dollars. The estimated price for each different weight was estimated using the econometric model shown in Appendix C[20].

Gross revenue is calculated as weight less shrink multiplied by the beginning lotsize less any death loss multiplied by price.

$$(17) \quad totrev_{(y,m)} = lbs * (1 - shrink) * lotsize * (1 - tdeath) * price$$

Where:
totrev is the total revenue in nominal dollars
lbs is the per animal average weight
price is the price for that weight of cattle
tdeath is the total deathloss over the feeding period.
shrink is the estimated shrink at selling
lotsize is the number of steers sold

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20 See section 6.2 for further details.

Gross revenue is then adjusted to account for selling costs which includes commission and trucking. These costs are subtracted from the gross revenue to obtain net revenue.

(18) $$netrev_{(y,m)} = totrev - comm - truck$$

Where:
netrev is the net revenue received
comm is the commission cost (total)
truck is the trucking charges

(19) $$comm_{(y,m)} = commcost * lotsize * (1 - tdeath)$$

Where commcost is the per head commission cost

(20) $$truckct_{(y,m)} = \frac{lotsize}{truckcap} * truck * distance$$

Where:
truckct is the total trucking costs
lotsize is the number of animals sold
truck is the per kilometre trucking costs
distance is the distance to market (assumed to be 96 kms)
truckcap is the truck capacity

The net revenue is shown in nominal dollars and is then converted to June 1986 dollars using the consumer price index.

$$(21) \quad realrev_{(y,m)} = netrev_{(m)} * \frac{CPI_{(June,\ 1986)}}{CPI_{(y,m)}}$$

Where:
realrev is the total net revenue in October dollars
CPI is the consumer price index (all goods 1986=100)
for the respective month and year

6.3.3 Profit and Percentage Return Calculation

The estimated profit is then calculated. The profit, in real terms, from feeding the calves is the total costs less the total revenue. Total costs consist of the feeding costs and the cost of the cattle. The cost of the cattle is the revenue that could have been realised if the calves were sold in October.

$$(22) \quad profit_{(y,m)} = realrev - totalcosts - cattlects$$

Where:
profit is the profit realised in October dollars
cattlects is the net revenue that would have been generated if the calves were sold in October

$$(23) \quad cattlects_{(y)} = (weanlbs * price * lotsize) - comm - truck$$

Where:
weanlbs is the average weaning weight of the calves
price is the average price received

$$(24) \quad profitperhead_{(y,m)} = \frac{profit}{100}$$

where:
profitperhead is the average profit for each calf weaned
100 is used as it is assumed that the producer starts with 100 steer calves

Profit can also be expressed as a percentage return. This allows for easy comparison, since it accounts for the length of time over which the investment is made. The profit can be expressed as a annualized percentage rate using the following equation. The following formula is an adaptation of the present value of a lump sum or discounting formula (present value = future value *(1/(1+interest rate)$^{\#\ of\ periods}$). In this case we are solving for the interest rate or realret.

$$(25) \quad realret = \left(\left(\frac{profit}{totalcosts + Cattlecosts}\right) + 1\right)^{\left(\frac{365}{feddays}\right)} - 1)$$

The annual percentage return is calculated as realret multiplied by 100. The various feeding regimes are compared using both profit per head and percentage return shown above.

It is noted that no financing costs have been included. Individual financing arrangements are different depending on the lending rate, the individual, and the amount financed. No specific financing arrangements are assumed, therefore the results are shown prior to the opportunity cost of financing. This study differs from other studies in one main area, that being the laid-in cost of the cattle. Most studies,

to date, have concentrated on the feeding industry. Their laid in costs are therefore purchase cost (price x weight) plus a buying commission plus trucking (Unterschultz 1991 and Freeze 1990). Whereas this study is concerned with the retained ownership of cattle. In this study the "laid in" costs are calculated as potential revenue (price x (weight less shrink)) less a selling commission less trucking charges. This difference amounts to forty to fifty dollars per head. Profits shown in this study therefore, will be greater than similar studies and should be accounted for when comparisons are made.

It is assumed that when the cattle are placed on pasture under feeding regime 450b no trucking charges are applicable. If trucking charges were applicable the returns under feeding regime 450b would have to be adjusted accordingly.

6.4 Results Cash Market Returns Simulation

This section will present the results from the first part of the simulation. The feeding regimes chosen for the weaning weight of four hundred and fifty pounds include a spectrum of finishing times as outlined in section 6.1. Feeding regimes 450b and 450c are the same until May each year. In May, the calves are either pastured in 450b (at a rate of gain of 2.1 pounds per day) or remain in the feedlot in 450c (at a rate of gain of 2.5 pounds per day). Feeding regime 450d finishes in July while 450b finishes in November. The major difference in all of the 450 pound feeding regimes is the rate of gain during the backgrounding stage. 450a gains 1.5 pounds per day, 450b and 450c gain 1.25 pounds per day and 450d gains 2.0 pounds per day at the start of the feeding regime. All of these regimes are included to illustrate the variation in marketing dates that can be chosen. Since the 550 and 650 pound calves have less flexibility in the marketing dates, only one possible feeding regime is presented.

The results presented in sections 6.4.1, 6.4.2 and 6.4.3 show that each year is different and the feeding regime that was best one year may not be the next. It does indicate that a producer who remains flexible, in the feeding regime chosen, is likely to earn higher profits, on average, than the producer who is less flexible. Generally speaking the last three months of production, the finishing stage, exhibited the highest returns. NTSP increases the profit level for all of the feeding regimes and decreases

the level of risk. A producer, who retains ownership only in a backgrounding program, would obtain higher levels of profit if the calves gain two pounds per day during the backgrounding stage versus 1.5 or 1.25 pounds per day. Calves kept through the winter, return higher profits, if they are pastured during the summer months.

6.4.1 Profit Per head

An average total profit per head for each month is shown in Table 3 and 4. It is noted that the profit levels shown are prior to financing. Table 3 assumes the producer does not belong to NTSP and table 4 assumes the producer participates in NTSP. The average for November is an average of the thirteen years, as if the calves were sold in November. For December it assumed that the cattle are kept until December then sold, and so on through to slaughter.

Very few of the months show a negative profit, those which do occur are, for the most part, confined to feeding regimes 450b and 450c. These two feeding regimes have the lowest rate of gain at the start of the feeding regime. This result is similar to that indicated by Cattle-Fax (1992). They found that calves pastured on winter wheat gaining one pound per day had to be fed to slaughter weight in order to benefit from retained ownership. Feeding regime 450b returns the highest per head profit of any of the feeding alternatives. It also is the feeding regime that takes the longest to complete.

In all of the feeding regimes the finishing stage is the most profitable in marginal terms.

Table 3
Average Total Profit per head without NTSP
Over the Entire Feeding Period*

Month	450a	450b	450c	450d	550a	650a
November	6.72	1.89	1.89	14.85	-2.39	-1.67
December	18.75	9.18	9.18	40.61	15.34	16.27
January	22.38	8.43	8.43	30.01	16.40	8.98
February	4.99	-12.07	-12.07	43.64	9.69	20.14
March	-3.45	-23.68	-23.68	29.82	10.20	23.04
April	-3.39	-13.29	-13.29	16.37	18.69	68.73
May	-6.43	-5.14	-8.76	53.52	70.62	107.67
June	9.49	3.90	-3.98	46.29	61.97	-----
July	17.05	35.37	23.15	69.56	-----	-----
August	24.93	37.12	20.88	-----	-----	-----
September	56.52	38.51	29.13	-----	-----	-----
October	-----	87.91	86.55	-----	-----	-----
November	-----	125.09	-----	-----	-----	-----

* All table entries are an average of the thirteen years of the study period. It is noted that the profit per head is calculated in a manner different from a number of previous studies. In similar studies the laid in cost of the cattle is purchase plus trucking and commission. In the study the calves are valued as if sold in October. This is calculated as the sale price of the animal less commissions and trucking. This difference ($40 - $60 per head) must be accounted for, when compared to others.

Feeding regimes 450b and 650a appear to offer the highest profit during the last three months, the finishing stage. On average the value added to feeding regime 450b during this stage is $87.97 per head (125.09 - 37.12), and to 650a is $87.53 (107.67 - 20.14) as opposed to 450a at $47.03 (56.52 - 9.49). Feeding regimes 450b and 650a market cattle prior to and after the summer months, respectively. This may indicate that the market for slaughter cattle in Alberta is weaker during the summer months.

Table 4
Average Total Profit per head with NTSP
Over the Entire Feeding Period*

Month	450a	450b	450c	450d	550a	650a
November	3.06	-1.77	-1.77	11.18	-6.05	-5.34
December	15.09	5.52	5.52	36.95	11.68	12.61
January	24.58	10.63	10.63	32.21	18.60	11.18
February	6.34	-10.72	-10.72	44.99	11.04	21.48
March	-2.49	-22.73	-22.73	30.78	11.16	23.99
April	-4.03	-13.93	-13.93	15.73	18.05	71.99
May	-6.77	-5.48	-9.09	53.19	70.28	112.53
June	8.19	2.59	-5.28	44.99	66.72	----
July	17.37	35.69	23.47	78.00	-----	-----
August	34.60	37.43	21.19	-----	-----	-----
September	68.64	38.93	29.54	-----	-----	-----
October	-----	89.26	98.98	-----	-----	-----
November	-----	141.54	-----	-----	-----	-----

* All table entries are an average of the thirteen years of the study period.

Each feeding regime's average profit per head increased if the producer belonged to NTSP. The average shown, is over the entire feeding period (1979 - 1991), therefore the actual per head increase is greater than shown, since NTSP did not begin until 1986. It is interesting to note that the greatest increase, $16.45 per head, (141.54 - 125.09) is in feeding regime 450b, already the most profitable in terms of profit per head. The smallest increase, $4.75 per head was found for feeding regime 550a.

It is noted that the profit per head in the first month in all of the feeding regimes falls. This is because the cattle have not been present on the farm for the required 60 day period. Therefore, the premiums paid under the NTSP program are treated as a sunk or non-recoverable cost.

The profit per head for each month of each year are included in Appendix E. All of the feeding regimes, in all of the years, show a profit before financing in at least one month and in many of the years a profit was offered in the first month or two. In a majority of years there is at least one month in which a loss occurs. In most cases the operator obtains the highest profit per head by finishing the cattle. In 1981, some of the highest profits were made of all the years. Slaughter cattle prices were higher than feeder cattle prices during September and October of 1981. This is the only time during the study period that this occurred. However the interest cost during these periods were also high. The most profitable years, 1981, 1985 and 1986, exhibited profits over $200 per head in many feeding regimes.

6.4.2 Annualized Return

The profits are also expressed in terms of an annualized percentage return. The percentage return allows a more appropriate comparison between the feeding regimes, since the length of time taken for each feeding regime is accounted for. As well, it allows for easy comparison with financing rates applicable to an individual farm. Table 5 shows the average annual percentage return and standard deviation of percentage returns (shown in parentheses) if the producer does not participate in NTSP. Standard deviation provides an indication of the dispersement around the average. Table 6 shows the average percentage return and standard deviation if the producer participates in NTSP.

Of the four hundred and fifty pound regimes, 450b is superior if the calves are retained until slaughter. 450b indicates average returns of 15.59% while 450a is 9.31%. The best return indicated for a slaughter program is 650a which exhibits average returns of 25.14%.

The relative rankings, of the feeding regimes vary if comparing by total profit or an annualized return. For example, comparing regimes by average total profit, feeding regime 450b is superior to 650a ($125.09 versus $107.67 table 3), however when comparing by an annualized return 650a is considered superior (15.59 versus 25.14 table 5). The length of the investment is the driving force behind this.

Table 5
Average Return (%) per head and Standard Deviation of Return excluding NTSP
Over the Entire Feeding Period

Month	450a	450b	450c	450d	550a	650a
November	23.38 *(41.5)	8.90 (36.4)	8.90 (36.4)	54.08 (56.3)	9.85 (54.1)	6.27 (42.0)
December	29.68 (50.2)	15.84 (44.8)	15.84 (44.8)	66.35 (63.9)	17.56 (36.9)	17.43 (44.9)
January	20.16 (29.3)	8.32 (26.2)	8.32 (26.2)	26.59 (26.0)	12.80 (21.2)	6.29 (20.6)
February	4.78 (19.2)	-4.96 (17.3)	-4.96 (17.3)	28.94 (25.1)	6.43 (16.0)	9.56 (15.3)
March	1.46 (17.8)	-7.28 (16.2)	-7.28 (16.2)	16.37 (19.8)	6.57 (16.6)	9.21 (11.4)
April	2.20 (18.9)	-1.21 (18.8)	-1.21 (18.8)	9.17 (20.8)	9.12 (21.4)	20.70 (22.6)
May	1.88 (19.4)	2.21 (19.0)	1.44 (19.5)	17.94 (22.1)	19.30 (25.2)	25.14 (23.2)
June	5.21 (17.0)	3.57 (16.0)	1.98 (16.4)	11.95 (18.6)	13.86 (18.2)	----
July	4.98 (12.5)	9.27 (13.0)	6.93 (14.4)	14.32 (14.8)	----	----
August	4.99 (11.1)	7.75 (11.1)	5.01 (12.0)	----	----	----
September	9.31 (12.5)	6.70 (11.4)	5.40 (12.0)	----	----	----
October	----	12.65 (10.2)	12.12 (10.8)	----	----	----
November	----	15.59 (9.71)	----	----	----	----

* Number in parenthesis is the standard deviation of return for that month over the thirteen year study period.

The feeding regimes starting with 450 pound calves are different mainly in the rate of gain in the backgrounding period. The best backgrounding program in terms of return is 450d, where return for the first two to three month period averaged 50 - 60%. This indicates that the best backgrounding program is experienced with a rate of gain greater than 1.5 pounds per day. Feeding regime 450d allows the producer more opportunities to sell the calves during the production process, whereas 450b indicates that the cattle should be retained until slaughter. Feeding regime 450d exhibits more risk than the other 450 pound feeding regimes. For example, in November, the standard deviation (STD) was 56.3 for 450d and 41.5, 36.4 and 36.4 for feeding regimes 450a, 450b and 450c, respectively. In most months, with the exception of January, the risk is greater for feeding regime 450d.

The major difference between 450b and 450c is that the calves are pastured in 450b during the summer months. The pasture route, 450b, exhibits a higher rate of return over the summer months. This is attributed to pasture being a more cost effective method of increasing weight during the summer months. In nine out of thirteen years the returns were higher for feeding regime 450b during the summer months. Three out of the four years that 450b returns were lower were after 1985. This may indicate that the relative advantage of summer pasture is narrowing. In addition to higher returns, the cattle placed on pasture exhibited similar or lower levels of risk than those remaining in the feedlot. For example, in May the standard deviation for 450b was 19.0 and 19.5 for 450c, in October the standard deviation for 450b was 10.2 and 10.8 for 450c.

Table 6
Average Return (%) per head and Standard Deviation of Return including NTSP
Over the Entire Feeding Period

Month	450a	450b	450c	450d	550a	650a
November	12.54 (40.1)*	-0.61 (35.5)	-0.61 (35.5)	42.15 (59.2)	1.51 (51.8)	-0.98 (40.9)
December	24.05 (50.2)	10.80 (44.8)	10.80 (44.8)	58.97 (63.5)	13.12 (37.5)	13.55 (45.6)
January	22.17 (28.0)	10.29 (25.0)	10.29 (25.0)	28.61 (23.9)	14.93 (21.8)	8.03 (20.5)
February	5.76 (19.2)	-3.96 (17.3)	-3.96 (17.3)	29.86 (25.1)	7.31 (15.6)	10.28 (14.4)
March	1.96 (18.0)	-6.74 (16.3)	-6.74 (16.3)	16.76 (19.7)	7.00 (16.6)	9.61 (11.6)
April	1.84 (18.4)	-1.56 (18.2)	-1.56 (18.2)	8.76 (20.2)	8.74 (20.8)	21.38 (21.4)
May	1.65 (18.9)	1.99 (18.6)	1.22 (19.1)	17.64 (21.8)	19.07 (25.1)	26.05 (22.1)
June	4.76 (16.7)	3.15 (15.8)	1.56 (16.1)	11.55 (18.7)	14.65 (16.9)	----
July	4.91 (12.0)	9.17 (12.5)	6.83 (14.0)	15.82 (13.2)	----	----
August	6.68 (9.8)	7.68 (11.6)	4.95 (11.6)	----	----	----
September	11.19 (11.6)	6.67 (11.5)	5.36 (11.5)	----	----	----
October	----	12.73 (9.5)	13.84 (10.2)	----	----	----
November	----	17.72 (8.4)	----	----	----	----

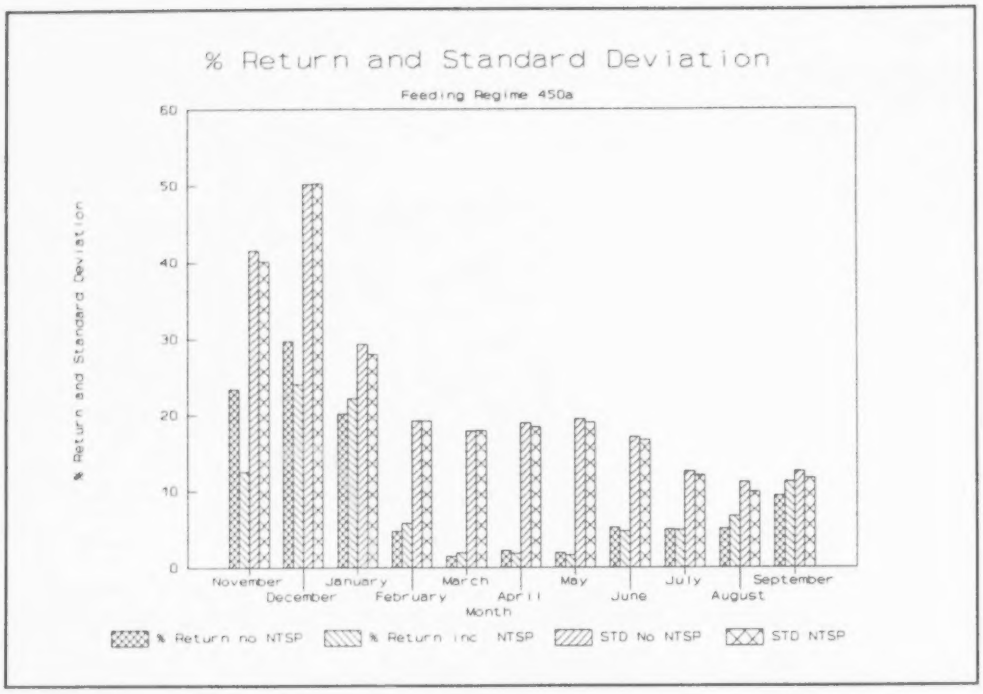
* Number in parenthesis is the standard deviation of return for that month over the thirteen year study period.

Table 6 outlines the real returns if the producer belonged to NTSP. Again the returns increase if the producer belongs to NTSP. The relative rankings of the feeding regimes remain unchanged after accounting for NTSP. The highest rate of return through to slaughter is 650a and the lowest is 450a.

Feeding regime 450a, shown in tables 5 and 6, is summarized in figure 1, which contains both the average returns for each month as well as the standard deviation of return for that month. The first two columns on the bar graph indicate the returns excluding and including NTSP, respectively. The last two columns indicate the standard deviation excluding and including NTSP, respectively. NTSP provides a higher level of returns after the initial 60 day period has past. In addition, the variability of return decreases for a majority of the months with participation in NTSP. The standard deviation of returns decreases as the production advances. This indicates that there is less risk as the calves are fed to a higher weight.

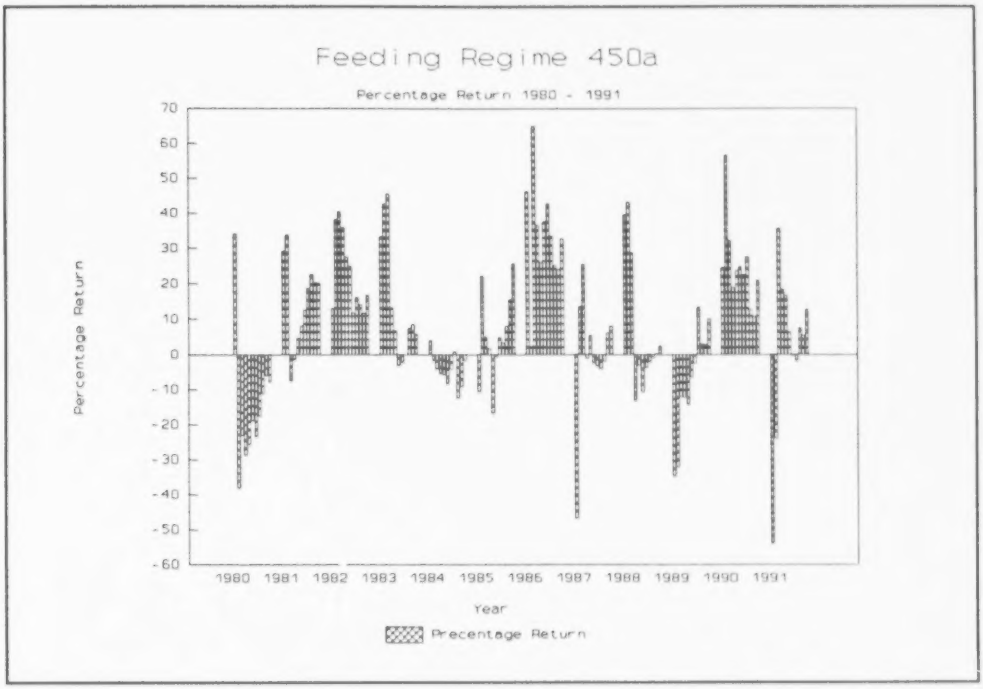
Of the four hundred and fifty pound feeding regimes, 450b exhibits the lowest variance over the entire feeding period. The highest variance overall is shown by 650a, and the highest of the 450 pound feeding regimes is 450d. With the exception of January and July, 450d had the highest standard deviation of the 450 pound feeding regimes.

Figure 1



An indication of the variability of returns that could be experienced is provided in figure 2 by considering the monthly returns experienced from feeding regime 450a. The return for each month in every year from October 1980 to September 1992 is shown in figure 2 for feeding regime 450a. The graph is included to show the variability in returns that can be experienced. The returns range from approximately seventy percent to minus sixty percent.

Figure 2



One of the reasons that feeding regimes 650a and 450b are more profitable than the others, if fed through the finishing stage, is the time of marketing. Feeding regime 650a ends production in May while 450b ends in November. The other regimes fall between these two extremes. Table 7 shows a monthly index of slaughter cattle prices over the period 1979 - 1992. The summer months and early fall months (June, July, August September and October) indicate that slaughter price is below average for the year during the summer months. During May and November the prices are above average. This accounts for a portion of the profitability of feeding regimes 450b and 650a.

Table 7
Monthly Index of Slaughter Cattle Prices
Over the Entire Feeding period*

Month	Average Slaughter Price $/cwt	Monthly Index of Slaughter Prices
December	81.81	100.91
January	82.10	100.27
February	81.40	100.41
March	82.37	101.61
April	84.04	103.67
May	84.10	103.74
June	79.55	98.13
July	78.31	96.60
August	78.07	96.30
September	78.03	96.26
October	79.68	98.28
November	83.35	102.82
Average	81.07	100.00

* Prices are in real dollars (1986=100)

Table 7 also indicates the value of simple market information. Producers who are aware of the seasonality in beef prices can institute production regimes timed to finish in the months where prices are higher on average. There is a need however, to keep abreast of the market conditions. If more producers change their marketing times to these higher priced months, increased supply could eliminate the relative advantage.

6.4.3 Stage to Stage Analysis

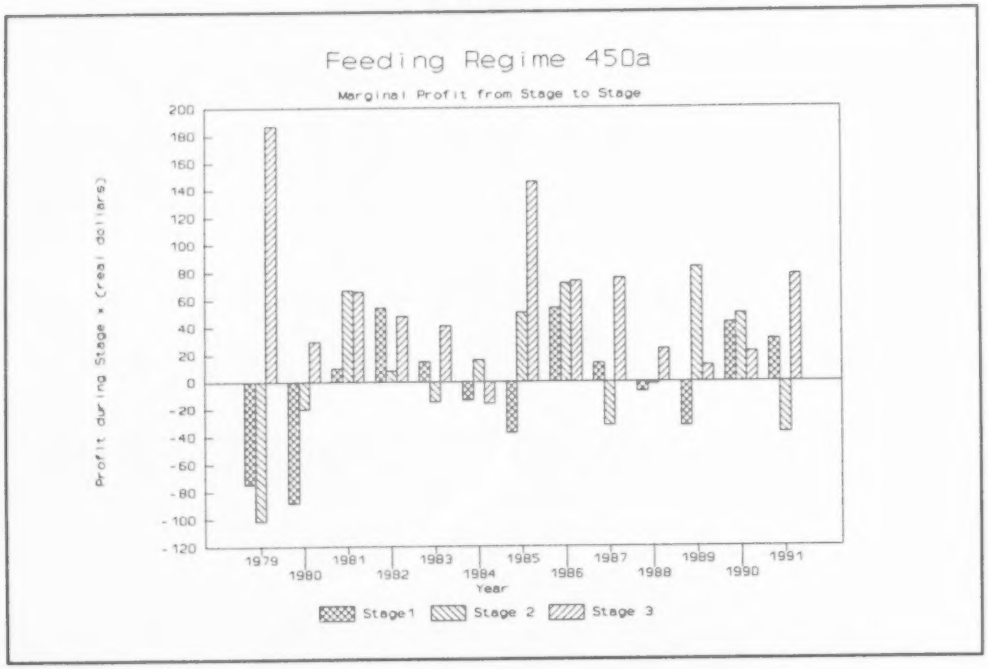
It is informative to view the profits on a stage-to-stage marginal basis rather than month-to-month, total basis. A producer may choose to feed cattle for only a portion of the feeding regimes outlined. In this case it is common to complete the feeding stage and then market the cattle. This is common for producers who background cattle and sell them in late winter or spring. The information obtained is therefore useful for the producer contemplating retaining ownership for only a portion of the feeding regime. The marginal basis is presented to show the profits that are made during each stage of production. Every time the ration and weight gain per day changes the profit per head is recalculated. The regimes are broken into 2 or 3 stages. The first stage (1.25 - 1.75 pounds per day) is referred to as the backgrounding stage. The second (1.75 - 2.5 pounds per day) is referred to as the growing stage, and finally the last stage (greater than 2.5 pounds per day) is referred to as the finishing stage. The results of this are shown below in the following figures. They show the marginal profit (loss) of going from one stage to the next including NTSP in real dollar (1986 = 100).

Feeding regimes 450a, 450b and 450c have three stages defined whereas, 450d, 550a and 650a have only two and the results are shown in figures 4-8. Feeding regimes 450a, 450b and 450c (the only regimes featuring stage 1) show a loss for the first stage during 1979, 1980, 1984, 1987, 1988 and 1989. The rest of the years were

profitable during this period or show a very slight loss.

Figure 3 shows the stage by stage marginal profit for feeding regime 450a. Referring to figure 3, 450a, a profit was made in the first stage of production in seven of the thirteen years. Stage two was profitable seven years, while stage 3 was profitable in ten out of the thirteen years. Stage three exhibited five of the six largest marginal gains in the years 1979, 1985, 1986, 1987 and 1991. The largest loss is attributed to stage 2 in 1979.

Figure 3



Figures 4 - 8 show the marginal profit from each stage of the production process, for the remaining feeding regimes. Feeding regimes 450b and 450c (figures 4 and 5) are the same for the first stage. Generally, if a profit was made in stage two or three, for one, the same was true for the other. The one exception to this is 1990, in which 450b shows a loss during stage 2 and 450c a gain. Of the 450 pound feeding regimes 450b produces the highest marginal gain in the last stage of production. In 1990 the marginal gain in the last stage was negative or very small for all of the feeding regimes, except 450b and 650a. The slaughter cattle market during this time period fell from $80.8 per hundred pounds in May to $72.1 per hundred pounds in November. For feeding regimes 450b and 450c a positive profit is shown in every one of the years during stage 3.

Feeding regime 450b showed a profit in five of the years during stage 1, eleven of the years for stage 2 and all of the years for stage 3. The highest five marginal gains occurred in stage 3 and the lowest in stage 1. This again shows that calves put on feeding regime 450b should be retained through to slaughter.

Feeding regime 450c exhibited marginal gains in stage 1 in five years, in stage 2 in eleven of the years and in stage 3 for all of the years. Feeding regime 450d showed a marginal profit in nine and twelve years for stages 2 and 3, respectively. Feeding regime 550a showed a marginal profit in eight and twelve years for stages 2 and 3, respectively. Feeding regime 650a showed a marginal profit in ten and

twelve years for stages 2 and 3, respectively. For feeding regime 650a six of the largest gains were in stage 3.

All of the feeding regimes exhibit the highest marginal profits in the last or finishing stage. This again shows the need for a producer to retain ownership until slaughter.

Figure 4

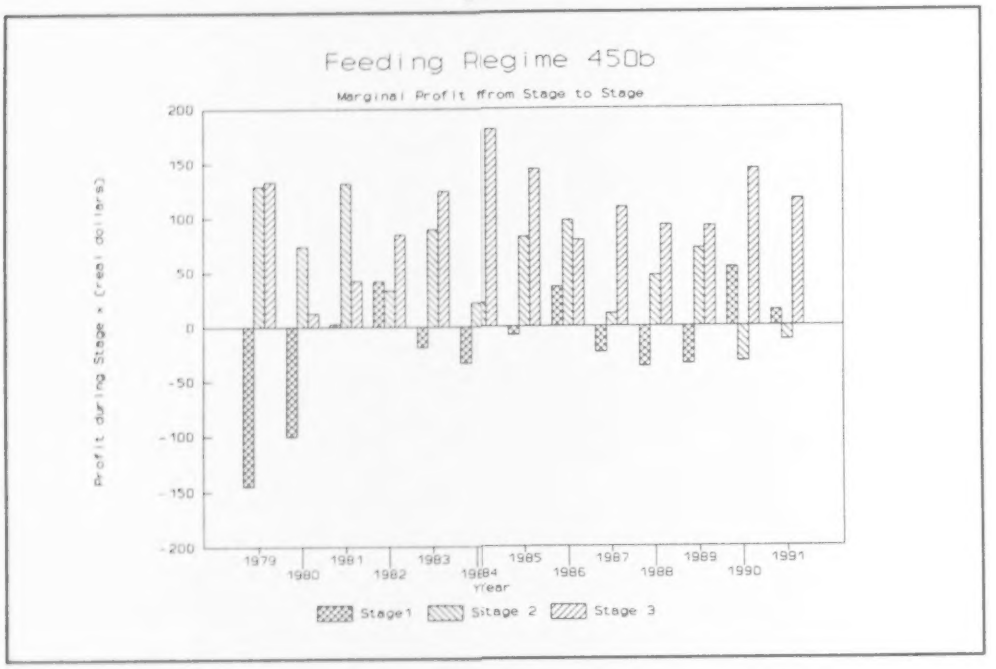


Figure 5

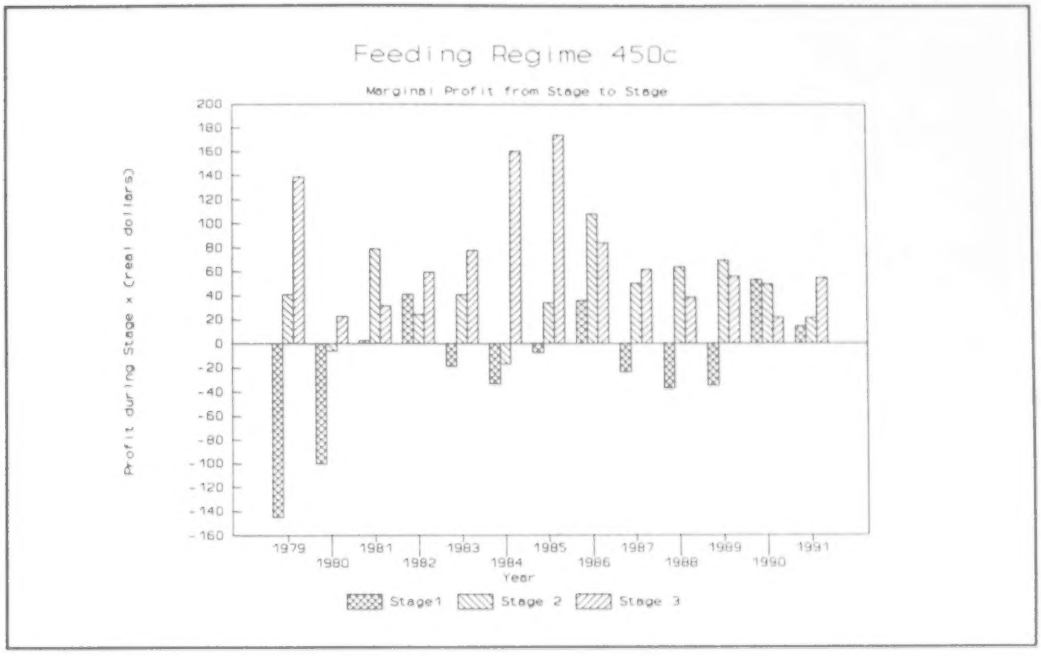


Figure 6

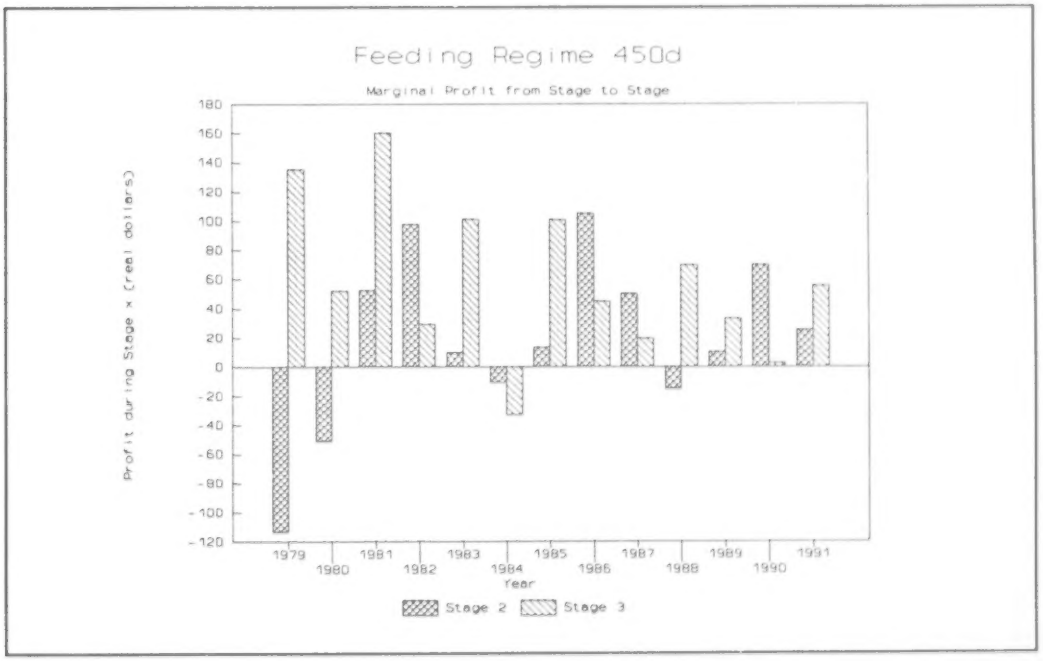


Figure 7

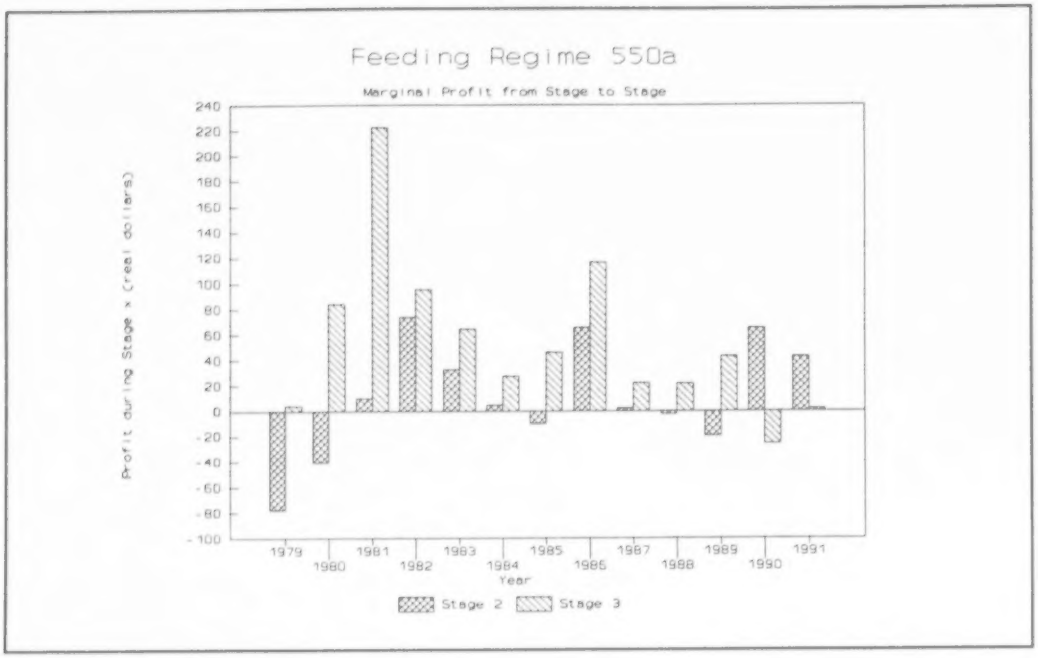
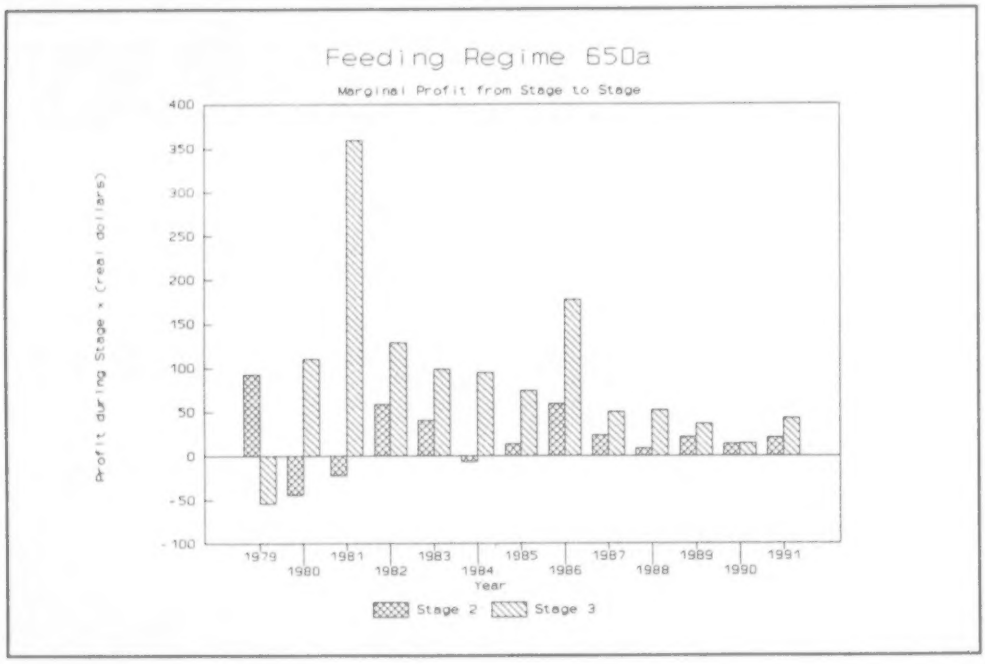


Figure 8



6.4.4 Conclusions

The results have shown that retained ownership of calves, past weaning, has been profitable for an Alberta producer. All of the feeding regimes exhibited a profit over the years 1979 to 1991. NTSP has been beneficial to the producer, retaining ownership, both in terms of increased profit and decreased risk. The highest returns are experienced if the producer retains ownership until the calves are slaughtered.

The best results for a backgrounding program are obtained when the calves are placed on a feeding regime gaining 2.0 pounds per day. The returns are higher at this rate of gain. There are two possible explanations for this result. The first is the marginal increase in the cost of feed for cattle gaining 2.0 pounds per day is small relative to feeding for a 1.25 pounds per day rate of gain. A large portion of the daily costs are fixed, such as yardage, bedding and health care. The second explanation is that this study has not addressed the discount or premium that is attributed to the fleshiness or condition of the cattle and therefore the price received for the calves may be over or under stated.

If the feeding regime adhered to allows an opportunity to place the calves on grass or remain in the feedlot, the grass option returns are higher. There are two possible reasons for this. First is the feed costs per pound of gain are less expensive for pasture than a custom feedlot. The second is the timing of marketing. As discussed earlier the seasonality of marketing can affect the price received.

6.5 A Simulation of Alternative Marketing Strategies

This section explains the methodology used in the second portion of the simulation. There are several ways to reduce the risk of feeding cattle. NTSP, futures markets, and options (put and call) are available risk management tools. NTSP and the futures market are examined in this study. The impacts of participation in NTSP and the futures markets are examined separately and together. In this portion of the simulation it is assumed that the cattle are always fed to slaughter weight.

This section contains three basic marketing alternatives, cash marketing, cash marketing with a routine hedge, and cash marketing with a selective hedge. The cash marketing alternative assumes the producer does not employ any hedging strategy (results from section 6.4). The routine hedge assumes that the producer places a hedge at the beginning of the feeding period every year. The selective hedge strategy makes a prediction of the outcome if a hedge is placed. If the outcome is favourable, a hedge is placed. One of the difficulties with employing a selective hedging program is the need to accurately predict future costs and returns. These predictions are required to evaluate the hedge and thus the outcome.

There are a variety of marketing strategies that could be adhered to. The feeding regimes developed in Section 6.1 are employed in this section, as well. The

marketing alternatives presented begin with the producer making a prediction of the total cost to feed the cattle to a slaughter weight. If the futures markets offer a favourable return an equal and opposite futures position is taken (a hedge is placed). If the return is not favourable then the producer remains in the cash market for one week[21] and then re-examines the return offered by the futures market. If a favourable return is presented at that point the cattle are hedged. Once a hedge is placed, the cattle are finished and the futures position is closed. The resulting profit would be the profit obtained in the cash market plus the profit made on the futures position. The results obtained in section 6.4 are included as the cash market profits in this simulation to provide a bench mark for comparison.

Section 6.5.1 defines hedging and develops the method employed to predict future cash prices. Section 6.5.2 contains the methodology used to predict the cost of feeding. The specific marketing strategies employed are introduced in section 6.5.3. Section 6.5.4 outlines the measures of risk employed. An analysis of the results is presented in section 6.6.

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21 Weekly data is employed in this section, so that the price movements of the futures market are more closely represented.

6.5.1 Hedging

A hedge is defined as the producer taking a futures market position opposite to that they hold in the cash market. For example, a producer who owns cattle would sell a futures contract for the time period in which the cattle will be marketed at slaughter weight. A full hedge is defined as hedging the entire pen of cattle as opposed to just a portion thereof. When a full hedge is placed, it is assumed that the producer sells futures contracts (goes short) and buys them back at the end of the feeding period thus closing the contractual obligations. It is also assumed that the producer is able to hedge 100% of the cattle. This assumption allows the producer to purchase futures contracts equalling production rather than in constant units of 40,000 pounds.

The final month of a futures contract (October for an October contract) is referred to as the delivery month. During this month deliveries are made against open contracts. For each feeding regime, the futures contract considered is that contract which expires after the production is completed. For example feeding regime 450a ends in September of every year. The contract considered, therefore, is the October contract. This is so that the contract obligations are closed prior to the delivery month and the complications of delivery are avoided. Feeding regime 650a employs the June contract, 550a and 450d the August contract and 450b and 450c the December contract.

The Chicago Mercantile Exchange's futures price for live cattle is different than the actual price an Alberta producer receives. This difference reflects hauling costs, exchange differences, etcetera. The difference between the futures price (in Canadian dollars) and the price actually received is defined as basis.

$$(26) \quad basis = (futpr * exch) - slaughterpr$$

Where:
futpr is the futures contract considered
exch is the exchange rate ($Can/$US)
slaughterpr is the slaughter price at the delivery point

After placing a hedge, the risk to the producer is shifted from price risk to basis risk. An estimate of basis for the month in which the cattle will be finished is made. This basis prediction is subtracted from the futures price, (converted to Canadian dollars) to provide an estimate of the cash price at the time of delivery. Mean Square Error (MSE) is used as a measure of the effectiveness of the prediction. MSE is defined as:

$$(27) \quad MSE = \frac{\sum_{i=1}^{i=N} (predpr_i - actpr_i)^2}{N-1}$$

Where:
predpr is the predicted price for month i
actpr is the actual price for month i
N is the number of observations

Previous studies, including Koontz, et al. (1992), Leuthold (1979) and Garcia, et al. (1988) have indicated that the futures market is a poor predictor of the future

price as the length of time to delivery increases. Koontz, et al. (1992) felt the futures market provided a poor forecast of the future price for non-storable commodities if the future contract is more that 5-6 months from delivery but improved as the contract neared delivery. In this study forecasts of future prices are made from seven (650a) to thirteen (450b) months prior to delivery. For this reason a number of simple methods of forecasting cash prices were evaluated. Table 8 shows a portion of the prediction methods that were tested. The months are those months in which production ends in each of the feeding regimes.

Table 8
Results of Future Cash Predictions

Method of Prediction	Nov MSE[1]	Oct MSE	Sept MSE	July MSE	June MSE	May MSE
1) 3 Month average of cash prices	49.34	46.67	40.75	33.30	48.16	52.32
2) Futures less 3 month ave. of basis	54.23	58.48	56.79	43.13	61.82	64.89
3) Futures less Current basis	72.56	68.65	58.18	47.02	56.74	58.93
4) Futures less ave. of Last two basis from same month	71.39	68.38	64.53	45.65	68.56	75.63
5) Futures less an average of last year's basis times a three year moving monthly index of basis	51.39	52.18	59.32	42.11	49.89	47.94

[1] Mean Square Error

Each October (at weaning) a prediction of the future cash price is made using the methods outlined in table 8. The method first employed is a three month average of previous cash prices. In methods 2 to 5, a prediction of the future cash price is calculated by subtracting a predicted basis from the futures price. For example, a basis prediction is made for the month of September (when the cattle are

finished under 450a) and subtracted from the October futures contract price. This provides an estimate of cash prices for next September. This estimate of the cash price becomes predpr in the MSE equation (28).

The first prediction examined in Table 8 is a three month average of cash prices. Therefore, an average of the cash price in August, September and October is used as a prediction of the future cash price.

The second method employed, in table 8, is a three month average of basis. Therefore the basis from August, September and October are averaged to provide an estimate of the future basis. The third method uses the current basis (October) as a prediction of basis. The fourth method is an average of the basis for the same month from the last two years. For example, an average of the basis from September 1978 and September 1979 are used as an estimate of the basis in September 1980. The last method is an average of the last twelve month's basis multiplied by an seasonally adjusted index from the last 3 years.

The first method evaluated, a three month average of cash prices, is a superior predictor of future cash prices in five out of the six months shown. This indicates that the basis risk is as substantial as cash price risk. This likely occurs because the prediction period is long.

When a prediction of future cash price is required for a marketing alternative, method 5 is used[22]. Of the methods evaluated to predict future cash price (futures less basis) this is considered to be the best. Any of the models chosen from the above would provide similar results. When models are chosen in this fashion, the writer has the advantage of hindsight in choice of basis predictors. This model may or may not be an appropriate model for future feeding periods.

6.5.2 Prediction of Costs

The cost to raise the calves for each feeding regime is estimated using October values. At weaning the producer estimates the cost to raise the calves to slaughter weight using known October prices. This prediction is made by estimating the feed costs and feedlot costs for the entire feeding process. This would be similar to the producer purchasing the feed requirements for the entire feeding period in October[23]. However the actual costs, as if the feed was purchased monthly, are used in the calculation of returns. A comparison of the estimation of costs and actual costs that are incurred if the producer purchased every month is included in Table 9. The prediction verses actual over the thirteen years are very close on average.

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22 The risk measure of MSE, section 6.5.4.2, requires that the producer make a prediction of future returns. A cash price forecast is required for this prediction, as well. The method used in this study is method 1 , a three month average of cash prices, since it is shown to be the best predictor in the majority of cases.

23 Many producers have a supply of feed on hand in October for the ensuing year. Their costs, therefore may be more in line with the predicted costs.

They is only one to four dollars per head difference across the feeding regimes for the whole period. However, the differences within a given year are larger. For the most part the longer feeding regimes are more variable than the shorter ones. The only exception to this is feeding regimes 450b and 450c, where the prediction of costs is more risky for 450c and it is the shorter regime. This occurs because the prediction of pasture costs are less variable than other feed costs.

Table 9
Comparison of Actual and Predicted Feeding Costs

	450a $/hd		450b $/hd		450c $/hd		450d $/hd		550a $/hd		650a $/hd	
year	Pr	Act	Pr	Act	Pr	Act	Pr	Act	Pr	Act	Pr	Act
1979	731	767	727	765	752	792	697	722	749	769	747	761
1980	757	754	731	720	783	773	715	722	735	747	769	778
1981	636	615	616	594	660	632	593	585	633	630	676	671
1982	639	630	637	651	660	657	599	591	634	632	686	681
1983	709	719	693	704	734	747	665	670	698	705	737	738
1984	748	737	730	708	776	755	702	702	742	748	780	783
1985	707	661	705	660	731	673	660	630	706	682	743	718
1986	687	681	698	694	702	695	646	641	692	688	739	731
1987	792	830	816	859	807	857	754	770	817	825	879	875
1988	811	797	815	805	835	815	763	759	824	827	852	853
1989	787	791	795	795	809	808	743	757	798	815	823	833
1990	749	731	761	749	769	747	706	699	749	749	821	818
1991	754	776	778	808	772	799	714	730	749	766	807	816
Ave.	731	730	731	732	753	750	689	691	733	737	774	773
RMSE	24		26		30		15		13		10	

Notes to Table 9
1) Pr is the Predicted Feeding Costs
2) Act is the Actual Feeding Costs
3) Does not include NTSP
4) Includes Cost of Calves
5) Does not include the opportunity cost of capital

6.5.3 Marketing Strategies

In addition to the cash market strategy examined in section 6.4, a naive or routine hedge and selective hedging strategies are chosen for evaluation. Selective hedge strategies examined are developed in the following manner. The expected costs of feeding the cattle are estimated using October prices. If the futures market "offers" a favourable rate of return a hedge is placed. If not, the producer remains in the cash market. In one week, the process is repeated and continues until the cattle are hedged or the production is completed.

6.5.3.1 Prediction of Returns

To this point, no financing or opportunity costs have been included. This avoids the complication of including an individual farm's financial structure. The producer can then make some estimate of the return that is desired or required for her/his operation. This is referred to as the break even rate of return. One can then compare this to the rate of return the futures market is "offering" . The break even return is defined in real terms indicating that it is adjusted for inflation. By using this percentage return the producer can estimate the future cash price in Canadian dollars that he or she would have to obtain in order to achieve the desired rate of return.

The first step in predicting the return offered by the futures market is to estimate the total revenue in Canadian dollars that will be generated from the sale of the calves at slaughter. The prediction of future price in Canadian dollars is multiplied by the ending weight of the cattle and the number of cattle that will be sold. It is assumed that there will be no gain or losses from the futures position in making the predictions.

(28) $futCAN\$ = ((futprUS\$ * exch) - prbasis) * endwt * catno$

Where:
futCAN$ is the Future Predicted gross revenue
futUS$ is the hedged price ($US/cwt)
prbasis is the predicted basis
exch is the exchange rate ($Can/$US)
endwt is the ending weight of the cattle
catno is the number of slaughter calves sold

An estimate of the nominal return is calculated by the following formula. The costs are subtracted from the gross revenue to provide an estimate of profit[24]. The profit is then converted to a nominal return.

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24 One of the costs of participating in the futures market is the opportunity cost of margin. For prediction purposes it is assumed that the initial margin ($1000.00 US per contract) will be sufficient for the entire feeding period. It is also assumed that the real cost of this initial margin is small.

$$(29) \quad exret_{(nominal)} = \left(\left(\frac{futCAN\$ - totalct - broke}{totalct + broke}\right) + 1\right)^{\left(\frac{365}{feddays}\right)} - 1$$

Where:
exret $_{(nominal)}$ is the expected nominal rate of return
futCAN$ is the Future Predicted gross revenue
broke is the brokerage fees for the future market transaction
totalct is the predicted total costs to slaughter
feddays is the number of days on feed for each feeding regime

The nominal return is then converted to a real return by the following equation.

$$(30) \quad exret_{(real)} = \left(\frac{(exret_{(nominal)} + 1)}{(prinfl_{(Oct,Y)} + 1)}\right) - 1) * 100$$

Where:
exret $_{(real)}$ is the expected real rate of return
exret $_{(nominal)}$ is the expected nominal rate of return
prinfl is the predicted inflation rate

$$(31) \quad prinfl_{(Oct,y)} = \left(\left(\frac{CPI_t}{CPI_{t-3}}\right)^{\left(\frac{365}{days_t}\right)} - 1\right) * 100$$

Where:
prinfl$_{(Oct,Y)}$ is the predicted rate of inflation in October of year Y
CPI is the Consumer Price Index for month t (1986=100)

A comparison of the expected real return is made to the predicted real prime rate offered in October. The prime rate therefore must be converted to real terms. An estimate of the real prime rate is made in the following equation:

$$(32) \quad realprime_{(Oct,Y)} = \left(\left(\frac{1 + prime_{(Oct,Y)}}{1 + prinfl_{(Oct,Y)}}\right) - 1\right) * 100$$

Where:
$realprime_{(Oct,y)}$ is the predicted real prime rate in October of Year Y
$prinfl_{(Oct,y)}$ is the predicted inflation for year Y
$prime_{(Oct,y)}$ is the nominal prime interest rate for October year Y

If the futures market is "offering" more than the break-even return then the cattle are hedged. Once the cattle are hedged the producer finishes the cattle and closes the futures position. If the producer finds that the futures market is "offering" less than the break even the producer would wait and examine the futures market at a later date[25]. The methodology outlined above, is combined with some target return to determine if it is appropriate to institute. Many different selective hedging targets were examined, however target returns of 4%, 6%, 8%, 10%, and 12% above the real prime rate are presented here.

6.5.3.2 Actual Return Calculation

The actual returns under each of the marketing alternatives is calculated. The profits from the first part of the simulation, section 6.4 are added to profit (loss) from the hedge less brokerage fees less the cost of margin to arrive at a profit for the entire program. The annualized rate of return is shown in following equation.

---

25 Note: The estimate of inflation, basis and costs are not updated as time progresses during the year.

$$(33) \quad actret = \left(\left(\frac{pro_{csh} + pro_{hdg} - broke - margin}{totalct + broke + margin}\right) + 1\right)^{\left(\frac{365}{feddays}\right)} - 1$$

Where:
actret is the actual return real rate of return
pro_{csh} is the real profit from the cash market
pro_{hdg} is the real profit form the hedge
broke is the real brokerage fees
totalct is the predicted total costs to slaughter
feddays is the number of days on feed for each feeding regime
margin is the real cost of margin and is calculated in equation 35

The level of margin required to service a contract varies as the price of the futures contract changes. This level of margin can be substantial, (see section 6.6.3). The margin held to service a contract is returned to the producer, when the hedged position is closed and the profit collected or loss paid. However during the time when the producer is hedged the cost of margin in real terms can be substantial. For this reason the real cost of margin is included as a cost in this study. It is noted that the margin can be a negative cost or advantage to the producer.

$$(34) \quad margin = \sum_i \Delta margin_i * \frac{CPI_{OCT}}{CPI_i}$$

Where:
margin is the real cost of margin
$\Delta margin_i$ is the change margin required from $margin_{(i-1)}$[26]
CPI is the consumer price index.

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26 For more details of how the margin per week is calculated see section 6.6.3.

The realized annual returns can then be compared to a scenario where no hedging occurred (results from simulation part A). In addition, a routine hedge is included for comparison. A routine hedge is defined as the producer hedging at the time the calves are weaned (week 1) and the hedge is closed when the calves are marketed. These hedges are placed regardless of price.[27]

6.5.4 Risk Measurement

Risk is measured in three ways for this analysis. Each of the feeding regimes are of different lengths and therefore the risk comparisons are difficult at best. These difficulties are outlined in the following sections.

6.5.4.1 Standard Deviation

The first way that risk is measured is in terms of standard deviation (STD). Standard deviation is calculated as follows:

---

27 For the feeding regimes 450b and 450c the December contract is used. This contract was not always trading when the calves were weaned. On those years (1981, 1982, 1983, 1988 and 1989) the routine hedge was placed in the first week the contract was traded. This occurred as early as week 2 in 1981 to as late a week 12 in 1982.

$$(35) \quad STD = \left(\frac{\sum_{i=1}^{N} (realret_i - \overline{realret})^2}{N-1}\right)^{\frac{1}{2}}$$

Where:
$realret_i$ is the % return in real terms for period i

$\overline{realret}$ is the mean of the real return

Standard deviation is not considered an accurate measure of risk as one implicitly assumes that the operator expects to achieve the average amount each period. Also standard deviation assumes the knowledge of returns in future periods is known, since they are used to calculate the mean. Thus, standard deviation as a measure of risk ignores any biases in return forecasts. Two alternative risk measures are developed to provide additional measures of risk.

6.5.4.2 Mean Square Error and Root Mean Square Error

Mean Square Error (MSE) is also employed as a measure of risk. Mean square error is most often used where there is a prediction and an actual price or return. The measurement is the sum of the squared errors.

$$(36) \quad MSE = \frac{\sum_{i=1}^{N} (exret_{real,i} - realret_i)^2}{N-1}$$

Where:
MSE is Mean Square error
$exret_{real,i}$ is the expected real rate of return for period i
realret is the actual real return experienced
i is the year

Root Mean Square Error (RMSE) is the square root of MSE. RMSE is difficult to use in the selective hedging analysis for a number of reasons. First, what is the relevant prediction of return to be used in calculating RMSE? Is it the prediction made in October or should it be the expected return when the hedge is placed? If it should be the prediction from October, then some of the information, hedged price, is not included in the estimate. Also, if the hedge is expected to be profitable then the risk measure is biased. If, on the other hand, the prediction is updated when the hedge is placed, should the cash position also be updated at that time? If a comparison to remaining in the cash market strategy is desired, then should the prediction of return for this alternative be updated when the hedge is placed? MSE and RMSE are difficult to incorporate into this analysis and this study and therefore are employed to compare the no hedge and routine hedge alternatives only. MSE and RMSE is an appropriate measure in these cases since the hedge, in the routine hedge strategy, is placed when the calves are weaned. This allows for a prediction of return to be made at that time, the same as the cash strategy.

6.5.4.3 Target Square Error and Root Target Square Error

There is a need to develop a risk measure that effectively reflects the risk level experienced and fits within the framework of the analysis. Squared error analysis is accepted as a method of measuring risk. From the definition of selective hedging marketing strategies, the producer attempts to achieve at least prime plus X return.

If the producer is always attempting to receive prime plus four, perhaps this could be used in the calculation of risk. The targeted return could then be used in place of the expected return in the MSE calculation. Target squared error (TSE) is therefore, defined in a slightly different manner. This presumes the producer set out to achieve prime plus some level X. The expected level (exret) becomes prime plus X in the previous formula. Root target square error is the square root of TSE.

There are obvious problems with TSE as a measure of risk. This measure does not include any of the market information available at the time the calves were placed on feed. Also, does it bias the results to assume that the market will consistently return prime plus X? For example, if the futures market predicts a return of 10 percent less than the prime rate, is it rational to assume that a return of prime plus 10 percent is achievable. Should the target return change from year to year to reflect this potential bias?

None of the risk measures outlined above is perfect. Standard deviation has been employed in the past as a measure of risk, but it does not employ all of the market data available (predicted returns) and, on the other hand, it employs too much (future information used to calculate an average return over the study period). MSE when calculated in a traditional method requires that the producer make a prediction of return. This is then compared to the amount actually received. This study allows the producer to hedge at any time during the production process.

Should the prediction be made in October or when the hedge is placed? If no hedge is placed what should be the prediction of return? TSE in the other hand does not include any market data available when the prediction is made. TSE also does not update the forecast even if a hedge is placed in the first week.

6.6 Results

This section contains the results from the second part of the simulation. Section 6.6.1 contains the risk and return results, 6.6.2 has the time to market analysis, and finally section 6.6.3 contains the margin analysis.

6.6.1 Return and Risk

Tables 10 and 11 and figures 9 through 16 present the results obtained in the second portion of the simulation. Many of the results for the feeding regimes are similar. Feeding Regime 450a is presented in full detail, and the remaining regimes are discussed in terms of differences from 450a. The contract used for 450a is the October futures contract, since this production regime ends in September.

The following two tables, 10 and 11, contain the returns experienced for feeding regime 450a under each of the hedging alternatives. Table 10 is calculated without NTSP participation, table 11 includes NTSP. The no hedge returns assumes that the producer remains in the cash market. Prime plus X is the target that the producer set out to achieve during the year in question. An average of the returns as well as the three measures of risk are included.

A matrix of RTSE estimates are presented in tables 10 and 11. Of these the most interesting are the elements along the diagonal. That is where the selective hedging strategy (along the top row) is the same as the target (down the first column). For example if a producer had target return of prime plus 6, and used a hedging strategy of prime plus 6 the RTSE estimate is 10.21 (table 10) or 8.66 (table 11). These diagonal elements will form the bases for discussion of the results.

The off diagonal elements are included for two reasons. The first, so that direct comparisons can be made to the no hedge and routine hedge options. In addition a producer may wish to achieve an average return of prime plus 6. In order to achieve this level of return the producer employs a hedging strategy of prime plus 8. The off-diagonal elements would indicate the deviations from the target of prime plus 6. The RTSE for the above producer would be 11.63 (table 10) and 10.10 (table 11).

If the producer did not participate in NTSP, table 10, the routine hedge decreased returns by approximately one half from 9.31 to 4.77. At the same time the risk increased as measured by STD, RTSE or RMSE. The increase in risk ranges from 1.03 (from 12.5 to 13.53 STD) to 6.02 (from 10.4 to 16.42 RMSE). This represents a increase in risk from 8.2% to 57.9%. This is expected in that the basis risk was estimated to be greater than the slaughter price risk and suggests that long term routine hedges should be avoided.

Table 10
Feeding Regime 450a: Percentage Real Returns
Using Hedging Strategies NTSP Excluded

Year	No Hedge	Prime + 4%	Prime +6%	Prime +8%	Prime +10%	Prime +12%	Routine Hedge
1979	0.97	7.16	8.81	0.97	0.97	0.97	4.05
1980	-7.88	6.60	8.36	-7.88	-7.88	-7.88	5.59
1981	20.01	32.95	32.95	32.39	32.96	31.73	32.95
1982	16.66	14.87	16.91	18.94	20.65	16.66	7.10
1983	5.63	10.26	12.09	11.44	11.44	5.63	6.56
1984	-1.80	12.06	13.68	11.53	11.34	-1.80	6.90
1985	26.91	25.89	27.15	30.11	31.68	26.91	23.42
1986	33.96	18.55	18.20	18.04	21.77	26.38	4.21
1987	-3.53	-11.95	-5.59	-3.61	-1.80	-1.80	-24.09
1988	1.19	1.19	1.19	1.19	1.19	1.19	-1.71
1989	11.28	11.80	11.28	11.28	11.28	11.28	-5.91
1990	3.65	6.12	6.12	3.65	3.65	3.65	-2.27
1991	13.98	7.89	12.19	12.27	13.19	13.19	5.19
Average	9.31	11.03	12.56	10.79	11.57	9.70	4.77
STD.	12.50	11.06	10.06	12.10	12.55	12.58	13.53
Prime +4	12.45	11.14	10.25	11.32	11.81	12.31	15.59
Prime +6	12.97	11.40	10.21	11.63	11.96	12.78	16.61
Prime +8	13.80	12.03	10.60	12.28	12.46	13.55	17.83
Prime+10	14.87	12.96	11.36	13.23	13.27	14.58	19.19
Prime+12	16.14	14.14	12.42	14.43	14.35	15.82	20.67
RMSE	10.40						16.42

Notes:
1) Prime +4, 6, 8 and 10 is risk measured by Root Target Square Error
2) RMSE is Root Mean Square Error
3) STD is standard deviation of returns

Table 11
Feeding Regime 450a: Percentage Real Returns
Using Hedging Strategies NTSP Included

Year	Cash	Prime +4%	Prime + 6%	Prime +8%	Prime +10%	Prime +12%	Routine Hedge
1979	0.97	7.16	8.81	0.97	0.97	0.97	4.05
1980	-7.88	6.60	8.36	-7.88	-7.88	-7.88	5.59
1981	20.01	32.95	32.95	32.39	32.96	31.73	32.95
1982	16.66	14.87	16.91	18.94	20.65	16.66	7.10
1983	5.63	10.26	12.09	11.44	11.44	5.63	6.56
1984	-1.80	12.06	13.68	11.53	11.34	-1.80	6.90
1985	25.54	24.54	25.78	28.71	30.27	25.54	22.10
1986	32.55	17.32	16.97	16.82	20.50	25.06	3.13
1987	7.93	-0.56	5.83	7.81	9.62	9.62	-12.85
1988	2.27	2.27	2.27	2.27	2.27	2.27	-0.61
1989	10.05	10.57	10.05	10.05	10.05	10.05	-6.94
1990	20.79	23.20	23.20	20.79	20.79	20.79	14.73
1991	12.69	6.67	10.93	11.00	11.91	11.91	4.00
Average	11.19	12.92	14.45	12.68	13.45	11.58	6.67
STD.	11.63	9.51	8.61	11.08	11.52	11.87	11.69
Prime +4	11.25	9.59	9.16	10.16	10.79	11.34	13.06
Prime +6	11.48	9.47	8.66	10.10	10.57	11.50	13.98
Prime +8	12.07	9.81	8.65	10.46	10.77	12.02	15.13
Prime+10	12.98	10.55	9.13	11.21	11.35	12.86	16.47
Prime+12	14.13	11.62	10.02	12.26	12.26	13.96	17.95
RMSE	7.64						13.26

Notes:
1) Prime +4, 6, 8 and 10 is risk measured by Root Target Square Error
2) RMSE is Root Mean Square Error
3) STD is standard deviation of returns

Appendix F contains summary statistics for the five remaining feeding regimes. Results from all of the four hundred and fifty pound feeding regimes indicate that the risk increases if a routine hedging strategy is followed. The smallest increase in risk occurs using the STD risk measure, followed by RTSE and RMSE. Feeding regimes 550a and 650a, show a reduction in the level of returns, and also a reduction in the risk as measured by STD and RTSE (and RMSE for feeding regime 650a) for a routine hedge marketing strategy. The returns fell by 1.03 percent (from 14.65 to 13.62) for feeding regime 550a and 5.01 percent (from 26.05 to 21.04) for 650a, the risk fell by 1.07 (from 16.86 to 15.79) for 550a and by 6.37 (from 22.05 to 15.68) for 650a as measured by STD. This result translates to a decrease in risk of up to 33%. The RMSE for 550a increased under the routine hedging strategy. Feeding regimes 550a and 650a require the shortest amount of time to complete.

A routine hedging strategy does not appear to be desirable as risk management tool if the production horizon is greater than 8 months. Producers who wean calves at 450 pounds should look to marketing alternatives, other than a routine hedge. As the production period shortens (650a or 550a) the routine hedge can be used as a viable risk management alternative. These results are consistent with previous research which shows that routine hedging is an effective risk management alternative for short feeding periods (Unterschultz, 1991).

In all of the feeding regimes under all of the hedging strategies the level of returns increased if the producer participated in NTSP (table 11). In addition, the level of risk fell in every case. An example of this is feeding regime 450a under selective hedging strategy prime plus six percent. The average return increased by 1.89 percent (from 12.56 [table 10] to 14.45 [table 11]). The risk, as measured by STD, decreased by 1.45 (from 10.06 [table 10] to 8.61 [table 11]). It is concluded that NTSP has been a benefit to producers, since the level of risk decreased and the level of returns increased in all cases.

Selective hedging strategies can improve the return as well as decrease the level of risk. Feeding regime 450a under a hedging strategy of prime plus six percent provides the highest level of returns as well as the lowest level of risk, regardless of whether the producer participates in NTSP or not. The returns increased by 3.18 (from 9.31 to 12.56 [table 10]) or 3.26 (from 11.19 to 14.45 [table 11]) percent in real terms over the no hedge option. The risk level decreased by 2.76 (from 12.97 to 10.21 table 10) or 2.82 (from 11.48 to 8.66 table 11) as measured by RTSE.

The variability of returns, ie. the amount profit or loss in a specific year, are important to a producer. The results of the selective hedging strategies for feeding regime 450a are summarized in the following graphs. Figure 9 and 10 show the returns obtained each year under the selective hedging strategies, excluding and including NTSP, respectively.

Figure 9

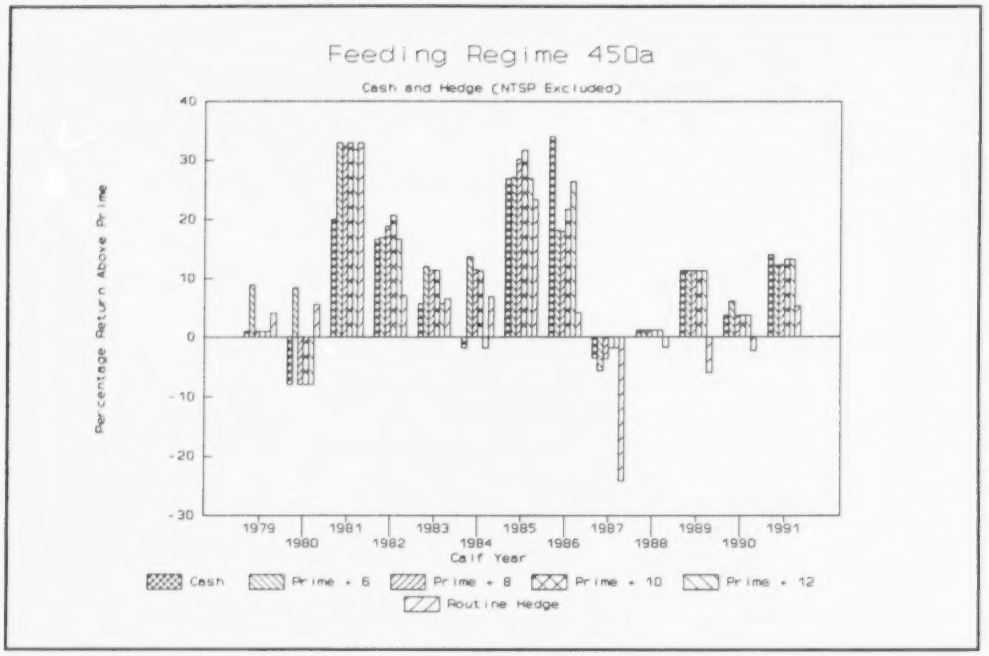
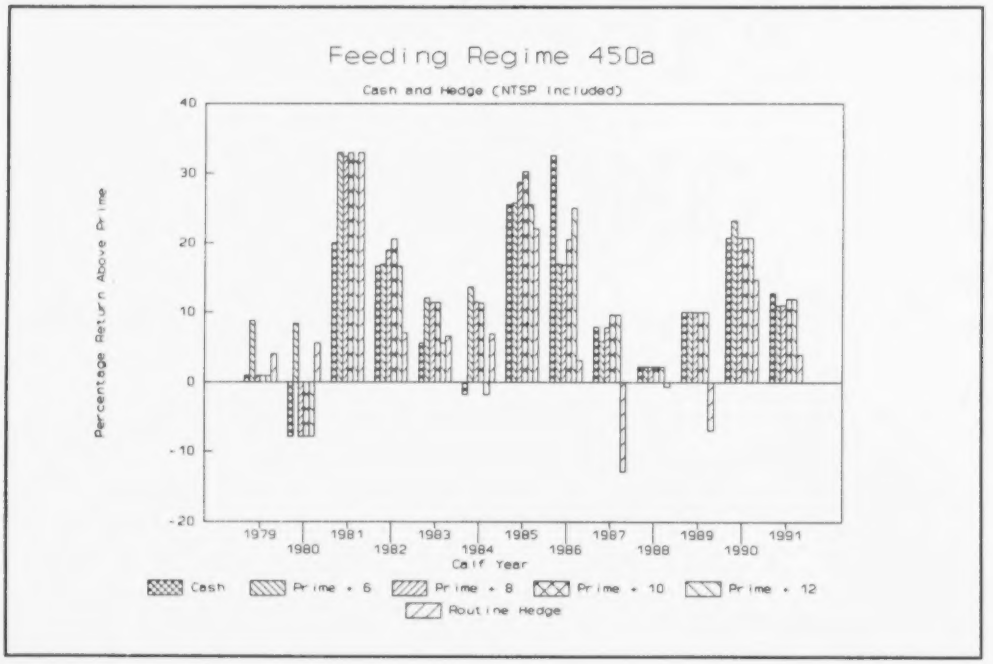


Figure 10

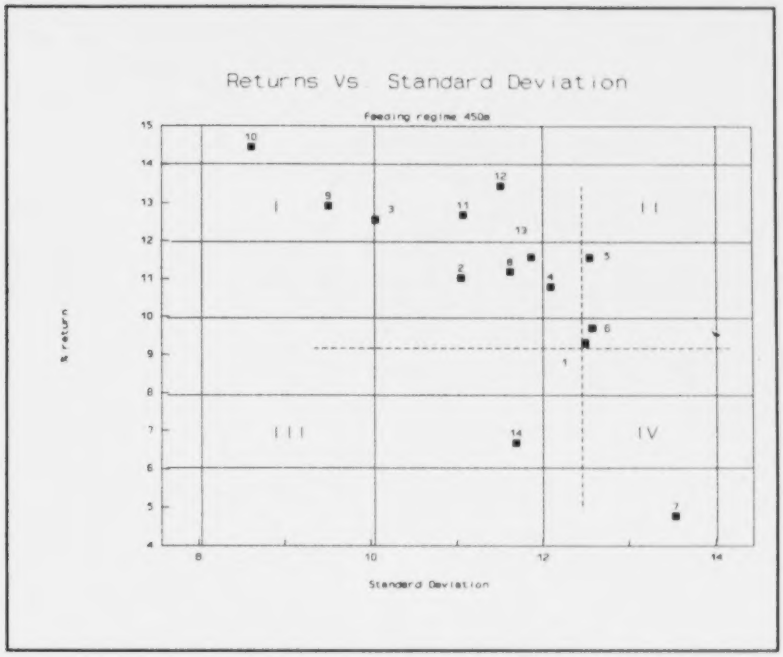


The selective hedging strategies are compared in the following manner. If the level of returns for one hedging strategy is higher and the risk lower, when compared to a different hedging strategy, the first is considered to be superior to the second. If the average return and risk is greater for one, then we cannot decide which is dominated. No specific utility function is assumed for the producer therefore a distinction between the two is not possible. The method chosen for comparing the strategies is referred to as the mean - variance efficiency criteria. An assumption that the returns are normally distributed is necessary for this comparison.

These results are best summarized in a mean - variance (EV) graph. Figure 11 is an EV graph for feeding regime 450a. This assists in ranking the various hedging strategies. The dotted lines intersect at 1 on the graph, which represents the no hedge, no NTSP option. The dotted lines divide the graph into 4 quadrants. The strategies in quadrant I dominate the base case or the no hedge, no NTSP case. Strategies in quadrant IV are dominated by the base case. The strategies in quadrants II and III cannot be distinguished from the base case unless a specific utility function is assumed. Although the dotted lines are drawn through the no hedge, no ntsp option, any point can be chosen and arbitrary lines drawn to show which strategy dominates or is dominated by the point chosen.

Strategies prime plus 4, 6, and 8 no NTSP (2-4) and prime plus 4, 6, 8, 10 and 12 including NTSP (8-13) dominate the base case, strategies prime plus 10 and 12 no NTSP (5 and 6) and routine hedge including NTSP (14) cannot be specified and strategy routine hedge no NTSP (7) is dominated by the base case. Of all of the marketing strategies shown the best for feeding regime 450a is prime plus 6 including NTSP (10).

Figure 11



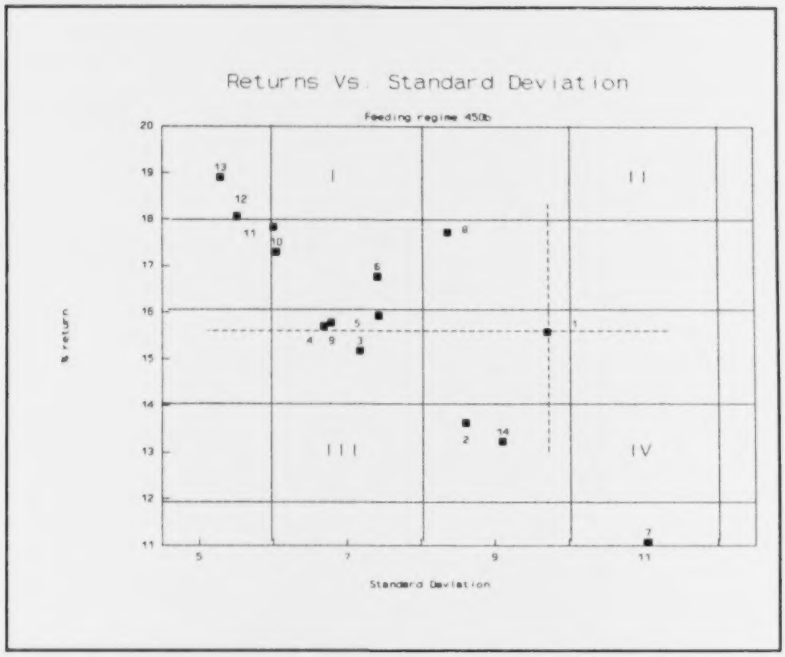
Strategy legend for Net Return and Standard Deviation

1) No hedge, no NTSP
2) Selective Hedge Prime plus 4, no NTSP
3) Selective Hedge Prime plus 6, no NTSP
4) Selective Hedge Prime plus 8, no NTSP
5) Selective Hedge Prime plus 10, no NTSP
6) Selective Hedge Prime plus 12, no NTSP
7) Routine Hedge, no NTSP
8) No hedge, including NTSP
9) Selective Hedge Prime plus 4, including NTSP
10) Selective Hedge Prime plus 6, including NTSP
11) Selective Hedge Prime plus 8, including NTSP
12) Selective Hedge Prime plus 10, including NTSP
13) Selective Hedge Prime plus 12, including NTSP
14) Routine Hedge, including NTSP

The other feeding regimes were less clear as to which hedging strategy was superior. Figures 12 - 16 are EV graphs for the remaining feeding regimes. For the other feeding regimes there were generally two or more hedging strategies that are considered efficient by mean - variance criterion. One exhibits higher returns and higher risk than the other, therefore no clear decision is made.

The hedging strategy best suited to feeding regime 450b is prime plus 12 including NTSP (13, figure 12). Feeding regime 450c preformed best with a hedging strategy prime plus 6 including NTSP (10, figure 13). Feeding regime 450d showed the best results under a prime plus 10 or 12 hedging Strategy (12 and 13 figure 14). The best results for 550a were found under a selective hedging strategy of prime plus 6, 8, or 10 including NTSP (10, 11 and 12 figure 15). The best results for 650a were obtained under prime plus 6, 10 or 12 including NTSP (10, 12 and 13 figure 16). Although the gains in return were modest for feeding regime 650a (from 0.54 prime plus 10 to 1.77 prime plus 12) the level of risk fell considerably from (8.18 prime plus 12 to 9.48 prime plus 10) as measured by STD. One possible reason for this is the length of the production horizon. 650a is the shortest of any of the regimes, therefore the prediction of future cash price is superior to the more distant predictions, as discussed previously. This is shown by the better risk reducing capabilities of a hedging strategy over the cash market where risk fell by as much as 45% as measured by STD.

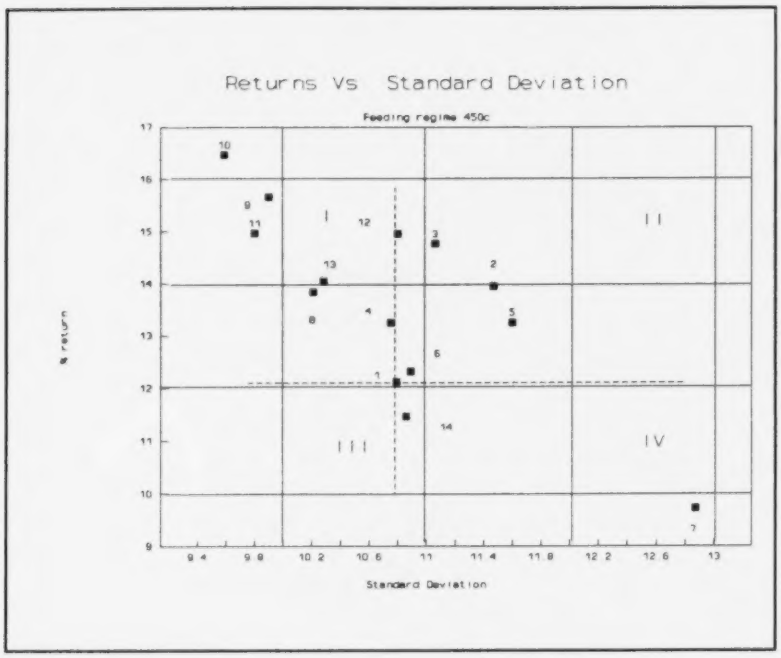
Figure 12



Strategy legend for Net Return and Standard Deviation

1) No hedge, no NTSP
2) Selective Hedge Prime plus 4, no NTSP
3) Selective Hedge Prime plus 6, no NTSP
4) Selective Hedge Prime plus 8, no NTSP
5) Selective Hedge Prime plus 10, no NTSP
6) Selective Hedge Prime plus 12, no NTSP
7) Routine Hedge, no NTSP
8) No hedge, including NTSP
9) Selective Hedge Prime plus 4, including NTSP
10) Selective Hedge Prime plus 6, including NTSP
11) Selective Hedge Prime plus 8, including NTSP
12) Selective Hedge Prime plus 10, including NTSP
13) Selective Hedge Prime plus 12, including NTSP
14) Routine Hedge, including NTSP

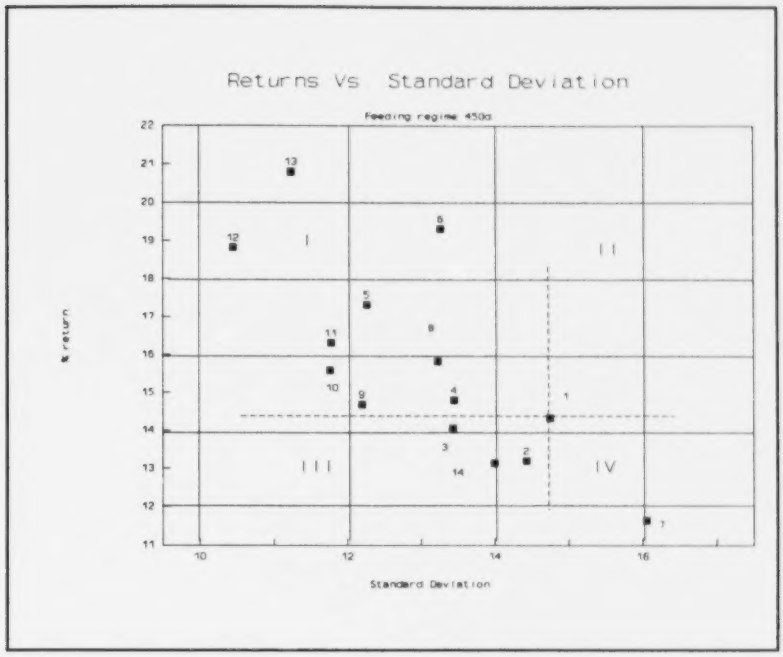
Figure 13



Strategy legend for Net Return and Standard Deviation

1) No hedge, no NTSP
2) Selective Hedge Prime plus 4, no NTSP
3) Selective Hedge Prime plus 6, no NTSP
4) Selective Hedge Prime plus 8, no NTSP
5) Selective Hedge Prime plus 10, no NTSP
6) Selective Hedge Prime plus 12, no NTSP
7) Routine Hedge, no NTSP
8) No hedge, including NTSP
9) Selective Hedge Prime plus 4, including NTSP
10) Selective Hedge Prime plus 6, including NTSP
11) Selective Hedge Prime plus 8, including NTSP
12) Selective Hedge Prime plus 10, including NTSP
13) Selective Hedge Prime plus 12, including NTSP
14) Routine Hedge, including NTSP

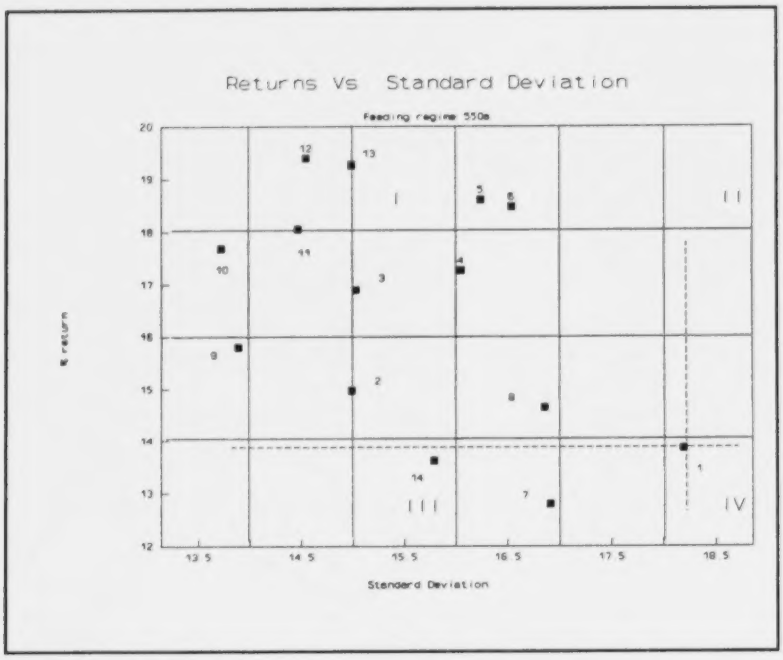
Figure 14



Strategy legend for Net Return and Standard Deviation

1) No hedge, no NTSP
2) Selective Hedge Prime plus 4, no NTSP
3) Selective Hedge Prime plus 6, no NTSP
4) Selective Hedge Prime plus 8, no NTSP
5) Selective Hedge Prime plus 10, no NTSP
6) Selective Hedge Prime plus 12, no NTSP
7) Routine Hedge, no NTSP
8) No hedge, including NTSP
9) Selective Hedge Prime plus 4, including NTSP
10) Selective Hedge Prime plus 6, including NTSP
11) Selective Hedge Prime plus 8, including NTSP
12) Selective Hedge Prime plus 10, including NTSP
13) Selective Hedge Prime plus 12, including NTSP
14) Routine Hedge, including NTSP

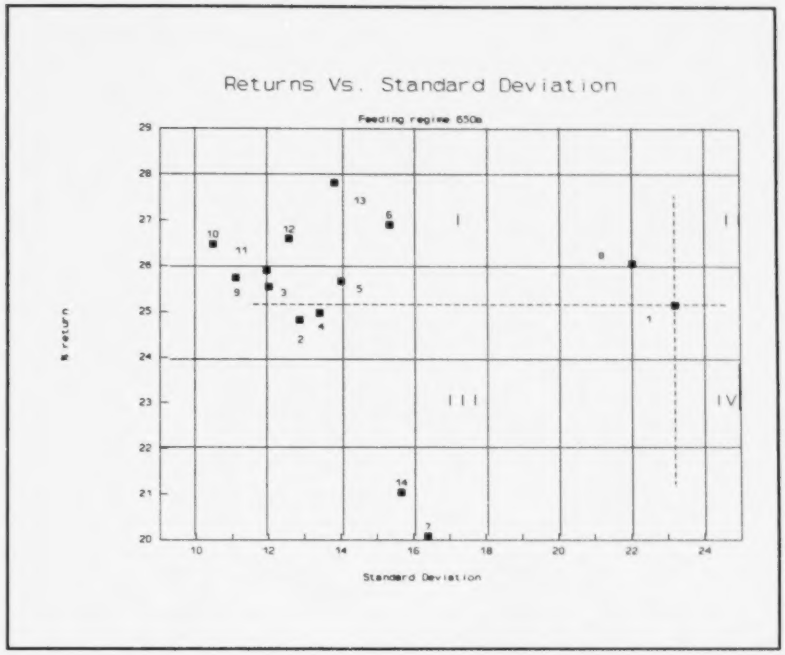
Figure 15



Strategy legend for Net Return and Standard Deviation

1) No hedge, no NTSP
2) Selective Hedge Prime plus 4, no NTSP
3) Selective Hedge Prime plus 6, no NTSP
4) Selective Hedge Prime plus 8, no NTSP
5) Selective Hedge Prime plus 10, no NTSP
6) Selective Hedge Prime plus 12, no NTSP
7) Routine Hedge, no NTSP
8) No hedge, including NTSP
9) Selective Hedge Prime plus 4, including NTSP
10) Selective Hedge Prime plus 6, including NTSP
11) Selective Hedge Prime plus 8, including NTSP
12) Selective Hedge Prime plus 10, including NTSP
13) Selective Hedge Prime plus 12, including NTSP
14) Routine Hedge, including NTSP

Figure 16



Strategy legend for Net Return and Standard Deviation

1) No hedge, no NTSP
2) Selective Hedge Prime plus 4, no NTSP
3) Selective Hedge Prime plus 6, no NTSP
4) Selective Hedge Prime plus 8, no NTSP
5) Selective Hedge Prime plus 10, no NTSP
6) Selective Hedge Prime plus 12, no NTSP
7) Routine Hedge, no NTSP
8) No hedge, including NTSP
9) Selective Hedge Prime plus 4, including NTSP
10) Selective Hedge Prime plus 6, including NTSP
11) Selective Hedge Prime plus 8, including NTSP
12) Selective Hedge Prime plus 10, including NTSP
13) Selective Hedge Prime plus 12, including NTSP
14) Routine Hedge, including NTSP

If the producer were able to predict the best hedging strategy, prior to the commencement of production, the returns could be increased and the level of risk decreased further. Further study is required to examine factors that would assist the producer in making this decision.

The results show that a selective hedging strategy can be successfully employed as an alternative method of marketing slaughter cattle. The selective hedging strategies outlined increased returns and decreased risk under a retained ownership scenario. In all of the feeding regimes, prime plus 6, 8, 10 or 12 was included as one of the best hedging strategies.

The national tripartite stabilization program (NTSP) has been a benefit to producers, through increased returns and decreased risk. NTSP can be augmented by a selective hedging strategy to further reduce risk and increase returns. The increase in returns from a selective hedging strategy of prime plus 6, 8, 10 or 12 did not significantly change if the producer belongs to NTSP or not.

A producer considering retained ownership should not employ a routine hedge if the production period is greater than 8 months. The routine hedge was costly both in terms of returns and risk. As the production horizon decreases, a routine hedge may be used as a risk management strategy.

6.6.2 Timing of Hedge Placement

For a producer considering a selective hedging program the amount of time it takes to place a hedge is an important consideration. In addition, the number of years in which hedges are placed is important. If a producer is going to evaluate a hedging strategy, they must have some indication of the time required to implement the strategy. The number of weeks that pass prior to a hedge being placed and the number of years in which no hedges are placed contribute to the amount of time required by the producer. For this reason a record was kept of the week in which the hedge was placed. For example, feeding regime 450a under a hedging strategy of prime plus 4. In 1979 a hedge was not placed in the first week, but was placed in week 2. In 1980 the hedge was placed in week 3. Under the routine hedging strategy a hedge was placed in the first week every year with the exceptions noted earlier.

Feeding regime 450a is again used as the standard and comparisons made thereto. There are 49 weeks from the last week in October to the last week of September. As expectations of return increase the number of weeks which pass prior to placing a hedge increases and the number of years in which a hedge is placed decreases. This is to be expected since a higher target return implies a higher cash price (and higher profits) so the market would have to move further upwards as the target increases. In addition, it is not surprising that the number of years that a

hedge is placed decreases as the target increases. In some years the market may offer a return of prime plus 6 but not prime plus 8. Selective hedging strategy prime plus four, placed hedges in twelve out of thirteen years. It required 17.2 weeks on average to place the hedge[28]. In 1988 no hedge was placed. Selective hedging strategy prime plus six required 21.2 weeks to place the hedge and hedges were placed in eleven out of thirteen years. The highest hedging strategy prime plus twelve percent required 42.5 weeks to place the hedge and hedges were placed in only four out of the thirteen years.

All of the feeding regimes followed a similar pattern to the above. Feeding regime 450d under hedging strategy prime plus four and six were the only selective hedging strategies in which hedges were placed in 1988. In addition, more hedges were placed under the feeding regime 450d than any of the others. Even at prime plus twelve percent, twelve hedges were placed out of a possible thirteen years. In feeding regimes 550a and 650a the majority of the hedges were placed in the first week. This is one potential reason why the routine hedging strategy did not cost as much in terms of returns over the other selective hedging strategies.

One possible reason for the above two exceptions is the length of production horizon. These three feeding regimes (450d, 550a and 650a) are the shortest of all of the regimes. As shown previously, the prediction of costs and returns are more

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28 This average is an average of those years in which a hedge was placed.

accurate as the prediction horizon decreases. In addition, as shown by Koontz, et al. (1992), the supply and demand information is beginning to affect the futures prices, making it a better predictor of future cash prices. With these better predictions we are better able to predict what level of return the market is offering.

In all of the feeding regimes; hedges were placed earlier in the production process prior to 1986. Before 1986 hedges were generally placed in the first weeks of production, after 1986 the hedges were generally placed after the twelfth week. In addition, more hedges were placed prior to 1986 than after (as a percentage of possible hedges). This may be partly due to the introduction of NTSP in 1986. The expected payments under this program may have increased calf prices relative to the United States. If this is correct the cost of production would have increased relative to the United States, where the futures contract is based. This would mean that the targeted return "offered" by the futures markets would occur less often. No formal tests were completed in this respect but it is included as one possible explanation of the results obtained.

In addition to following the week in which the hedge was placed, whether money was gained or lost for each hedge placed was traced. For feeding regime 450a under selective hedging strategy prime plus four, the producer made money in seven of the twelve years in which a hedge was placed (58%)[29]. Using the strategy prime

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29 This is calculated after brokerage fees and exchange rates are accounted for.

plus 6 the producer increased income in eight of the eleven years in which a hedge was placed (73%). Prime plus twelve provided additional income in two out of the four years in which a hedge was placed (50%). The routine hedge strategy provided additional income in 5 out of the thirteen years (38%).

This general trend was found for all of the feeding regimes. The best selective hedging strategy, as chosen by the mean - variance criterion, showed increased profits in a higher percentage of the years in which a hedge was placed. This agrees with expectations, since a profit from hedging increases the returns and hedging generally reduces the risk of lower returns.

In general, under a selective hedging program the amount of time that passes prior to a hedge being placed can be substantial. This indicates that a producer needs to be diligent and patient in following the markets as the desired return may not present itself early in production.

Also of concern to a producer is the level of margin required to service the hedged position since funds must be committed during the production process. The measurement of margin requirement and implications thereof are included in the following section.

6.6.3 Margin Analysis

A concern for anyone who is going to use the future markets as part of any marketing strategy is the cost of margin calls and interest on margin. This section examines the maximum, minimum and average margin required to service the hedge. Real cost of margin is included in the return calculation in section 6.5.3.2. This however does not indicate the amount of margin money that is required for any one contract. Margin is money held by the exchange to insure the participant can cover the loss that may result from the futures transaction. The level of margin required can substantially affect the cashflow requirements of the farming operation.

When a hedge is placed in section 6.4 it is assumed that the producer opens a margin account with the brokerage house. Each week the markets are re-examined to determine if there was an adverse price movement over the week[30]. An adverse price movement in this case is an increase in price. If the price increases the producer would have to pay more to re-purchase the contract than it was sold for. The required margin is calculated as follows:

(37) $$loss(gain) = (hedgepr * 400) - (Currentpr * 400)$$

Where:
loss(gain) is the amount lost or gained on the contract to date
hedgepr is the price the contract was sold ($US/cwt)
currentpr is the current price of the contract ($US/cwt)
400 is the contract size (in cwt units)

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30 This is done on a daily basis by the brokerage house. However for the purposes of this report it is assumed to be completed weekly.

The above equation is the loss or gain from one contract. The feeding regimes outlined required 2.5 to 3 contracts for a complete hedge - ie. ((100 hd * 1100 lbs/hd)/40,000 lbs/contract). This portion of the analysis is completed as a percentage of the contract value, therefore the results are the same regardless of the number of contracts purchased. If the futures price decreases, the hedged position profits, then no additional margin is required[31]. If the loss is less than $300.00 U.S. (1000 - 700) then again no additional margin is required. This amount, $300.00 U.S., is used as a loss of more than $300.00 U.S. would place the producer below the required maintenance margin level of $700.00 U.S. per contract. If the loss is greater than $300.00 then the producer must add additional margin equal to the loss. The total margin outstanding at that point would be the original margin ($1,000.00 U.S.) plus the loss. This exercise continues until the contract obligations are closed.

The maximum, minimum and average amount of margin required is then calculated. These levels of margin are expressed as a percentage of the contract value. This is repeated for all the hedging strategies outlined in section 6.5 as well as the routine hedge.

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31 If there is a gain in the market the producer can opt to have a portion of the margin returned.

Again the results for feeding regime 450a are presented in detail while the rest are examined by differences to 450a. The margin level is generally set at about five percent of the value of the contract, however this can increase or decrease depending on the market volatility. The routine hedge in every case was the most costly in terms of the amount of margin required.

The maximum margin required for the routine hedge was 30.1% of the value of the contract. The maximum level of margin was required in 1986. The lowest margin under the routine hedge is -11.68% (1980). This indicates that the producer would have had a positive margin account balance of 11.68 percent of the contract value in 1980. An average of the margin required each year indicated that the highest average margin required was 14.23% (1987)[32]. This indicates that in 1987 the producer is required to post an average margin of 14.23%. The average margin required across all of the years is 5.19% percent of the contract value. Figure 17 shows the weekly margin requirements for the years 1980, 1983 and 1986, under a routine hedge and feeding regime 450a.

Under feeding regime prime plus four the maximum margin required is 17.42%, the minimum is -12.59 and the average is 1.56%. The amount of margin continues to decrease as the targeted return increases. For example under the

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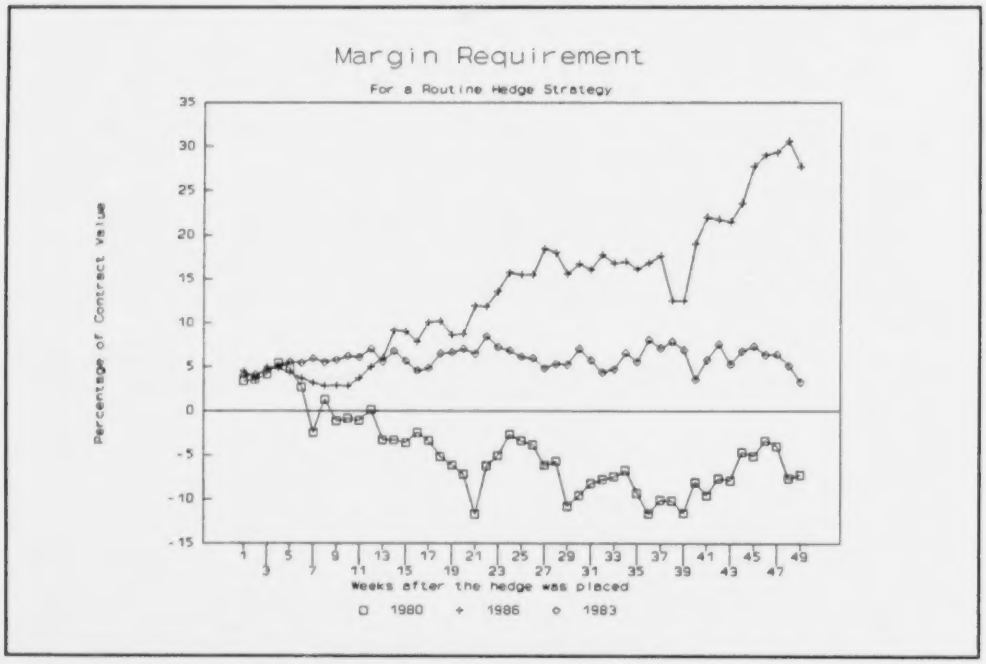
32 The average for any one year is calculated as an average of the margin required each week during which the hedge was placed.

hedging strategy prime plus 10 the maximum, minimum and average margin was 14.65%, -12.32% and 1.44% of the contract value respectively. This is not surprising since as the target return increases, the price "offered" must increase, and therefore the producer is hedging at a higher price. The higher the hedged price the lower the margin, as a percentage of contract value, required.

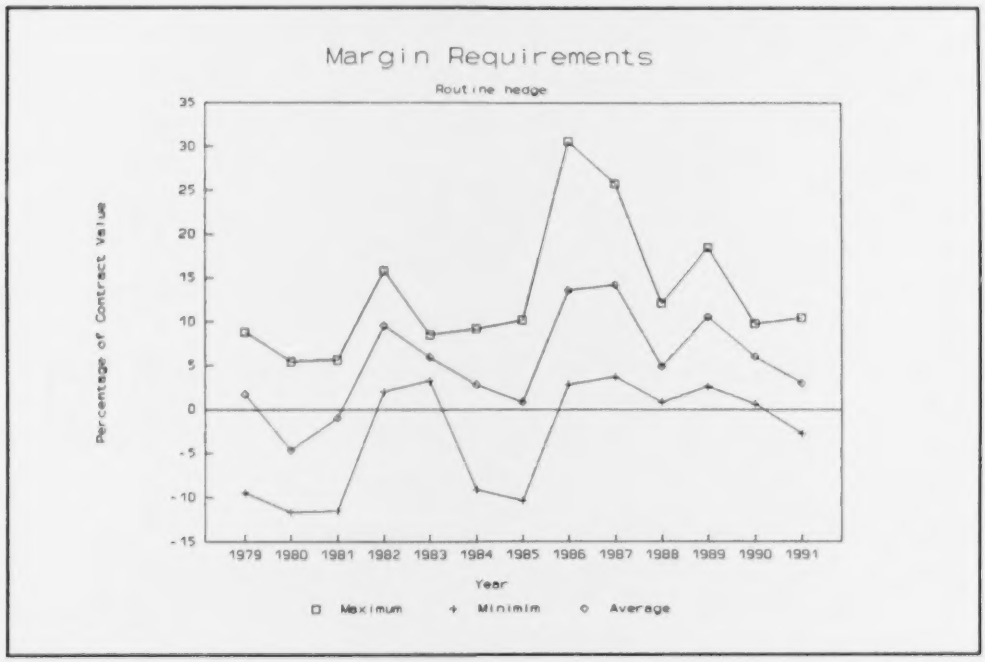
Under different hedging strategies the amount required each year varies. For the strategy prime plus 6 the producer's margin account, on average, was positive in 4 out of the 11 years in which a hedge was placed.

Figure 17



The maximum margin for each feeding regime under the routine hedge strategy was at least 25%, and the levels of margin commitment decrease as the target return increased. Figure 18 shows the maximum, minimum and average margin each year under the routine hedging strategy for feeding regime 450a.

Figure 18



A concern expressed by producers is the difficulty in obtaining the financing required to service margin accounts. Lending institutions may have concerns about security on the funds that are advanced to service margin accounts. For both the producer and lending institutions it is important to understand the level of margin that could be required. It is also important for both to understand that an increase

in margin does not in itself indicate that the producer has made a poor decision by hedging the cattle. It was shown in section 6.6.1 that even when the real cost of margin was included selective hedging alternatives are attractive. Only when studies such as this or farm level data is available will the producers and lenders be able to overcome this factor that inhibits the use of futures markets an other hedging strategies from being used as marketing tools.

6.7 Conclusions

The results have shown that retained ownership of calves, past weaning, has been profitable for an Alberta producer. All of the feeding regimes exhibited a profit over the years 1979 to 1991. NTSP has been beneficial to the producer, retaining ownership, both in terms of increased profit and decreased risk. The highest returns are experienced if the producer retains ownership until the calves are slaughtered.

The best results for a backgrounding program may be experienced when the calves are placed on a feeding regime, gaining 2.0 pounds per day. The returns are higher at this rate of gain, however so is the level of risk. If the feeding regime adhered to allows an opportunity to place the calves on grass or remain in the feedlot, the grass option returns appear higher. The advantage of this option appears to be narrowing. The seasonality of beef slaughter prices can influence the level of profit received and the feeding strategy that is adhered to.

Selective hedging strategies can effectively be used to increase returns and decrease the level of risk exposure to the producer retaining ownership. Selective hedging strategies of prime plus 6, 8, 10 or 12 including NTSP appear to be the best chose of those explored. The routine hedge option was not an attractive strategy during the study period. If the production period is reduced this strategy may increase its attractiveness. A selective hedging strategy can be costly in terms of the amount of time required to place the hedge and the level of margin required to service the hedge.

CHAPTER 7 IMPLICATIONS AND FURTHER STUDY

This chapter contains a summary of the results obtained and a look at issues which need to be examined further. The implications of the results generated are given in general terms.

7.1 Implications

The study shows that retained ownership of beef steers can be profitable over the long period. Each of the feeding regimes explored have characteristics that would appeal to producers.

If a producer plans to retain ownership, the calves should be kept until slaughter weight. All of the feeding regimes exhibited the highest level of profit when the calves were kept until slaughter. The timing of slaughter cattle sales should also be chosen carefully, since slaughter cattle have shown seasonal price differences in the past. An index of slaughter cattle prices indicates that the market has been lower during the summer months.

The best results for a backgrounding program are obtained when the calves are placed on a feeding regime, gaining 2.0 pounds per day. The returns are higher at this rate of gain, however so is the level of risk. If the feeding regime adhered to,

allows an opportunity to place the calves on grass or remain in the feedlot, the grass option returns are higher.

Using the futures market can reduce the risk and in some instances increase the revenue received. The routine hedge was not found to be a viable option for the marketing of beef calves over long production periods since the production horizon was not short enough to provide an accurate prediction of price using the futures market. The selective hedge strategies allow the producer to selectively hedge based on a target return. Using these strategies the returns were increased and/or risk was reduced. Each of the feeding regimes is best enhanced by one or two hedging strategies. For all of the feeding regimes hedging at a return of prime plus 6 - 12 percent was found to be best. These hedging strategies can be expensive in terms of the amount of margin required to service the contract (at times 20 - 30% of the contract value).

The producers using the futures market as a marketing strategy are advised that the cost of this strategy could be significant and a substantial line of credit needs to be established prior to the hedging. If a selective marketing strategy is followed the producer needs to be patient and require the finances to maintain a margin account.

The option value analysis completed does not provide the producer with any information that can be readily applied to the existing operation. If this study was completed in a different manner or the theory advances, there may be some implications that are directly helpful to the producer. It would appear that the selling and buying costs for the cattle market are not large enough to make the disinvestment decision irreversible.

7.2 Further Study Required

There are a number of areas in this study that could be improved. However the ground work and methodology has been developed and some results obtained. In most every area of the study there is room of improvement. The largest area would be in available data.

7.2.1 Available Data

One of the most important areas that could be addressed is price estimation. It is very apparent that the price of the calves throughout this simulation, to a large extent determine the profitability of retained ownership. Although this likely does not affect the results if the cattle are retained to slaughter weight it can greatly affect the profitability of each stage or month of feeding. It is therefore proposed that additional research be completed to estimate the factor(s) that determine the price

of feeder cattle. This would likely be best approached by obtaining actual auction market sale data. If a study was completed in the above respect, one could re-examine this report using various sizes and calves as well as various breeds.

In addition there are equal numbers of heifers born as bulls therefore this study should be updated to include heifer calves and the potential thereof.

Actual feedlot data would greatly assist this study as production risk would enter the problem. This would also be helpful in estimating which hedging strategy is most useful to that producer.

7.2.2 Cash Market Simulation

The study could be updated allowing for the price of the inputs to change the rations on a timely basis. This would improve the simulation presented. The assumption that the producer does not substitute away from relatively higher priced inputs is not correct and should be accounted for. The results should improve as the feedlot is allowed to develop a least cost ration during each feeding period.

7.2.3 Alternative Marketing Simulation

The alternative marketing strategies could be improved if the operator was allowed to sell the calves in October if a profit is not reasonably predictable. This would enhance the simulation by providing choices that are available to every cow-calf producer. The basis prediction was poor over the horizon in which it was predicted for this study. A structural regression model or time series model may provide a better prediction and thus enhance the simulation completed.

Risk estimation was a concern throughout is study. There is a need to develop a measure of risk that can be incorporated into this study and will provide a more accurate measure of the risk facing the producer.

This report has not included any implication of marketing using the futures options. This would allow the operator more alternatives in marketing and risk reduction. Futures options provide the producer with another method of managing risk. The use of forward or basis contracts should also be considered. Basis contracts may reduce or eliminate some of the risks encountered in longer production periods considered.

7.2.4 Option Value

This theoretical study could be repeated using the cow as the factory. The price of cows may well have a longer price lag time that would allow for an option to be estimated.

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APPENDIX A Parameters Used in the Production Functions

This appendix itemizes the parameters used in each of the production functions for each different weight gain. The ration for weight gains less than 1.45 kilograms per day (3.2 lbs per day) were taken from Alberta Agriculture Beef Herd Management. These rations were adjusted to reflect actual rations. For weight gains of 1.45 kilograms per day the production function developed by Coles (1989) and updated by Unterschultz (1991) is used.

Parameters for 0.577 kilograms (1.25 lbs) per day

lbs of barley per day	2.0
lbs of cereal silage per day	27.0
lbs of 32% supplement	0.25
Yardage ($/day)	0.15
Bedding ($/day)	0.04
Treatment ($/day)	0.10

Parameters for 0.680 kilograms (1.5 lbs) per day

lbs of barley per day	3.7
lbs of cereal silage per day	25.0
lbs of 32% supplement	0.25
Yardage ($/day)	0.15
Bedding ($/day)	0.04
Treatment ($/day)	0.10

Parameters for 0.907 kilograms (2.0 lbs) per day

lbs of barley per day	8.6
lbs of cereal silage per day	21.4
lbs of 32% supplement	0.4
Yardage ($/day)	0.15 1987
Bedding ($/day)	0.04 1987
Treatment ($/day)	0.10

Parameters for 1.0 kilograms (2.1 lbs) per day (Pasture)

lbs of barley per day	0.0
lbs of cereal silage per day	0.0
lbs of 32% supplement	0.5
Yardage ($/day)	0.15
Treatment ($/day)	0.10
Animal unit months	0.75
processing ($/head)	1.50 June 1987

Parameters for 1.134 kilograms (2.5 lbs) per day

lbs of barley per day	13.4
lbs of cereal silage per day	16.0
lbs of 32% supplement	0.6
Yardage ($/day)	0.15
Bedding ($/day)	0.04
Treatment ($/day)	0.10

Parameters for 1.45 kilograms (3.2 lbs) per day

lbs of barley per day	20.28
lbs of cereal silage per day	3.65
lbs of 32% supplement	1.00
Yardage ($/day)	0.15
Bedding ($/day)	0.04
Treatment ($/day)	0.10
Processing ($/head)	2.75* June 1987

* occurs during the first month of full feed.

Other Parameters	
Barley Transportation	$6.5/tonne
CBOP	$Various/tonne
Cereal Silage price	12.5 * $/bushel of barley
Commission	$17.0 per hear in March 1993
Feed Processing	$10.00 per tonne March 1993
Shrink	3-4 % of weight
Truck	$1.25 per kilometer
Truck distance	96 kilometres
Truck Capacity	Varies with total weight
Supplement price	$250 per tonne June 1986

Some of the above costs are single value numbers collected at different times during the simulation. These costs are then converted to a series of price using the following indexes:

Barley transportation costs are adjusted using two indexes. The petroleum index times 0.33 and the motor vehicle maintenance index for Alberta time 0.67 are used to adjust.

Cattle transportation costs are adjusted using two indexes. The petroleum index times 0.33 and the motor vehicle maintenance index for Alberta time 0.67 are used to adjust.

Commission price is adjusted using the western supply and services index.

Feedlot yardage is adjusted using the western supply and services index.

Bedding costs are adjusted using the western supply and services index.

Feedlot Processing costs are adjusted using the western supply and services index.

Treatment costs are adjusted using the Western Canadian Veterinary services index.

The supplement costs are adjusted using the prepared feed index for Western Canada.

APPENDIX B NTSP Premiums and Payouts

Table 12
NTSP Premiums and Payouts

Year	Month	Premiums Slaughter	Payouts Slaughter	Premiums Feeders	Payouts Feeders
1986	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	6.6	13.2	0	0
	5	6.6	13.2	0	0
	6	6.6	13.2	0	0
	7	6.6	0	0	0
	8	6.6	0	0	0
	9	6.6	0	0	0
	10	6.6	0	0	0
	11	6.6	0	0	0
	12	6.6	0	0	0
1987	1	6.6	0	0	0
	2	6.6	0	0	0
	3	6.6	0	0	0
	4	6.6	0	0	0
	5	6.6	0	0	0
	6	6.6	0	0	0
	7	6.6	0	0	0
	8	6.6	0	0	0
	9	6.6	0	0	0
	10	7.4	17.37	0	0
	11	7.4	17.37	0	0
	12	7.4	17.37	0	0

APPENDIX B Cont.

Table 12 continued
NTSP Premiums and Payouts

Year	Month	Premiums Slaughter	Payouts Slaughter	Premiums Feeders	Payouts Feeders
1988	1	7.4	37.91	0	0
	2	7.4	37.91	0	0
	3	7.4	37.91	0	0
	4	8.1	42.45	4.85	0
	5	8.1	42.45	4.85	0
	6	8.1	42.45	4.85	0
	7	8.1	100.95	4.85	32.79
	8	8.1	100.95	4.85	32.79
	9	8.1	100.95	4.85	32.79
	10	8.1	87.92	4.85	38.56
	11	8.1	87.92	4.85	38.56
	12	8.1	87.92	4.85	38.56
1989	1	8.1	17.04	4.85	0
	2	8.1	3.02	4.85	0
	3	8.1	0	4.85	3.96
	4	8.1	44.5	4.85	16.62
	5	8.1	59.83	4.85	23.68
	6	8.1	68.58	4.85	9.32
	7	8.1	49.3	4.85	0
	8	8.1	10.28	4.85	0
	9	8.1	17.35	4.85	1.65
	10	8.1	12.93	4.85	0
	11	8.1	29.21	4.85	0
	12	8.1	5.16	4.85	0

APPENDIX B Cont.

Table 12 continued
NTSP Premiums and Payouts

Year	Month	Premiums Slaughter	Payouts Slaughter	Premiums Feeders	Payouts Feeders
1990	1	8.1	0	4.85	0
	2	8.1	0	4.85	0
	3	8.1	11.96	4.85	11.45
	4	8.1	0	4.85	0
	5	8.1	10.23	4.85	0
	6	8.1	0	4.85	0
	7	8.1	0	4.85	0
	8	8.1	0	4.85	0
	9	8.1	0	4.85	0
	10	8.1	0	5.5	0
	11	8.1	0	5.5	0
	12	8.1	0	5.5	0
1991	1	8.1	0	5.5	0
	2	8.1	0	5.5	0
	3	8.1	0	5.5	0
	4	8.1	0	5.5	0
	5	8.1	0	5.5	0
	6	8.1	0	5.5	0
	7	8.1	33.68	5.5	0
	8	8.1	98.09	5.5	0
	9	8.1	131.06	5.5	0
	10	8.1	137.53	5.5	11.44
	11	8.1	189.53	5.5	51.59
	12	8.1	132.86	5.5	55.34

APPENDIX B Cont.

Table 12 continued
NTSP Premiums and Payouts

Year	Month	Premiums Slaughter	Payouts Slaughter	Premiums Feeders	Payouts Feeders
1992	12	8.1	132.86	5.5	55.34
	1	8.1	90.25	4.85	68.01
	2	8.1	17.13	4.85	54.13
	3	8.1	0	4.85	31.35
	4	8.1	0	4.85	2.6
	5	8.1	0	4.85	0.21
	6	8.1	0	4.85	0
	7	8.1	0	4.85	0
	8	8.1	0	4.85	0
	9	8.1	0	4.85	0
	10	8.1	0	4.85	0
	11	8.1	0	4.85	0

APPENDIX C Econometric Model to explain Feeder Cattle Price

Steer prices were obtained for the period January 1980 to December 1991[1]. There were prices collected for four weight groups. They are 4-500, 5-600, 6-700, and 800+ pounds. The price for each month are the dependent variable in this regression analysis. Various other independent variables were introduced but were not significant. By removing these from the regression analysis specification error may be introduced to the model. The model that seems to best explain the price in feeder cattle is shown below.

Variable Name	Estimated Coefficient	Standard Error	T-Ratio
LNTBILL	-0.063730	0.0079432	-8.0232
D1	0.0062182	0.0046379	1.3407
D2	0.0023068	0.0046566	0.49539
D3	0.016275	0.0046676	3.4869
LNSLA	0.29136	0.030122	9.6728
NTSP	0.050144	0.0058482	8.5742
LNLB	-0.084962	0.0092424	-9.1926
LNLGPR	0.66661	0.023652	28.184
CONSTANT	0.89494	0.14922	5.9976

R-SQUARE = 0.9361 R-SQUARE ADJUSTED = 0.9352

Durbin-Watson 2.2548

Where:
Feeder steer price is the dependent variable
LNTBILL is the natural log of the 90 day tbill rate
D1, D2, and D3 are intercept dummies for the 1st, 2nd and 3rd quarter for each year
LNSLA is the natural log of the slaughter price
NTSP is a intercept dummy for when NTSP was introduced
LNLB is the natural log if the calf weight
LNLGPR is the natural log of the feeder steer price lagged one period

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1 A similar regression was completed for the entire study period 1979 to 1992, however the results above were used in the analysis. The results of the two regressions were very similar, the only variable to change significantly is LNTBILL, which fell by approximately 20%.

APPENDIX D Minimum and Maximum profit per head & returns

Table 13
Maximum Profit per head without NTSP
Over the Entire Feeding Period

Month	450a	450b	450c	450d	550a	650a
November	24.37	18.93	18.93	30.68	30.44	25.12
December	83.65	72.16	72.16	108.09	80.97	100.65
January	68.01	51.65	51.65	56.57	56.04	49.62
February	56.58	36.30	36.30	106.81	57.75	60.06
March	58.20	34.01	34.01	97.30	84.47	68.68
April	96.71	87.30	87.30	121.51	147.67	175.62
May	134.20	117.31	123.45	190.76	231.86	264.07
June	127.71	99.65	110.16	166.91	191.11	0.00
July	116.30	131.33	146.40	166.14	0.00	0.00
August	136.87	135.11	159.84	0.00	0.00	0.00
September	208.89	141.86	173.34	0.00	0.00	0.00
October	0.00	184.77	222.13	0.00	0.00	0.00
November	0.00	219.28	0.00	0.00	0.00	0.00

APPENDIX D Cont.

Table 14
Maximum profit per head with NTSP
Over the Entire Feeding Period

Month	450a	450b	450c	450d	550a	650a
November	24.37	18.93	18.93	30.47	27.36	25.12
December	83.65	72.16	72.16	108.09	80.97	100.65
January	67.95	51.59	51.59	56.57	56.04	49.62
February	56.49	36.21	36.21	106.72	57.75	59.97
March	54.62	30.58	30.58	91.71	78.88	68.56
April	96.56	87.15	87.15	121.37	147.52	175.62
May	134.01	117.13	123.27	190.58	231.86	264.07
June	127.51	99.44	109.96	166.91	184.51	0.00
July	116.06	131.08	146.16	166.14	0.00	0.00
August	130.27	134.86	159.58	0.00	0.00	0.00
September	202.29	141.61	173.09	0.00	0.00	0.00
October	0.00	184.49	231.71	0.00	0.00	0.00
November	0.00	215.00	0.00	0.00	0.00	0.00

APPENDIX D Cont.

Table 15
Minimum Profit per head without NTSP
Over the Entire Feeding Period

Month	450a	450b	450c	450d	550a	650a
November	-23.35	-28.91	-28.91	-16.11	-55.57	-95.12
December	-34.45	-41.14	-41.14	-21.16	-20.35	-30.72
January	-30.53	-40.50	-40.50	-15.96	-23.75	-56.70
February	-52.98	-65.07	-65.07	-29.21	-34.05	-30.71
March	-61.19	-75.47	-75.47	-34.65	-49.57	-29.35
April	-85.26	-92.13	-92.13	-72.05	-84.00	-28.67
May	-127.25	-134.65	-140.66	-63.50	-37.76	18.10
June	-111.95	-108.83	-121.16	-45.14	-46.83	0.00
July	-61.81	-45.53	-73.72	-40.47	0.00	0.00
August	-54.06	-43.92	-71.23	0.00	0.00	0.00
September	-54.56	-71.34	-71.47	0.00	0.00	0.00
October	0.00	-15.55	-58.10	0.00	0.00	0.00
November	0.00	-10.19	0.00	0.00	0.00	0.00

APPENDIX D Cont.

Table 16
Minimum profit per head with NTSP
Over the Entire Feeding Period

Month	450a	450b	450c	450d	550a	650a
November	-31.45	-37.01	-37.01	-23.51	-62.97	-102.3
December	-34.45	-41.97	-41.97	-21.16	-28.45	-38.12
January	-30.53	-40.50	-40.50	-17.23	-28.64	-56.75
February	-52.98	-65.07	-65.07	-29.21	-34.05	-30.71
March	-61.19	-75.47	-75.47	-34.65	-49.57	-29.35
April	-85.26	-92.13	-92.13	-72.05	-84.00	-28.67
May	-127.25	-134.65	-140.66	-63.50	-37.76	24.94
June	-111.95	-108.83	-121.16	-45.14	-46.83	0.00
July	-61.81	-45.53	-73.72	-40.47	0.00	0.00
August	-54.06	-18.57	-71.23	0.00	0.00	0.00
September	-54.56	-40.84	-71.47	0.00	0.00	0.00
October	0.00	-15.55	-58.10	0.00	0.00	0.00
November	0.00	-10.19	0.00	0.00	0.00	0.00

APPENDIX D Cont.

Table 17
Maximum Return (%) per head without NTSP
Over the Entire Feeding Period

Month	450a	450b	450c	450d	550a	650a
November	85.82	62.54	62.54	120.32	117.27	69.52
December	156.74	128.72	128.72	225.46	120.14	155.44
January	66.00	48.28	48.28	66.12	56.43	37.91
February	37.09	24.03	24.03	76.78	40.02	30.73
March	27.47	17.29	17.29	46.03	34.59	26.09
April	38.07	34.65	34.65	48.74	52.16	62.60
May	43.26	38.26	40.09	62.12	76.92	77.10
June	33.90	26.83	29.35	49.57	46.54	0.00
July	25.37	30.23	33.02	39.66	0.00	0.00
August	25.50	26.77	30.37	0.00	0.00	0.00
September	33.96	24.63	28.57	0.00	0.00	0.00
October	0.00	28.27	31.98	0.00	0.00	0.00
November	0.00	30.33	0.00	0.00	0.00	0.00

APPENDIX D Cont.

Table 18
Maximum Return (%) per head with NTSP
Over the Entire Feeding Period

Month	450a	450b	450c	450d	550a	650a
November	85.82	62.54	62.54	115.05	117.27	69.52
December	156.74	128.72	128.72	225.46	120.14	155.44
January	64.90	47.48	47.48	66.12	56.43	37.91
February	36.51	24.03	24.03	75.55	40.02	30.59
March	27.47	17.29	17.29	45.08	32.04	25.78
April	37.53	34.15	34.15	48.05	51.51	62.60
May	42.67	37.73	39.53	61.30	76.92	77.10
June	33.45	26.46	28.95	49.57	46.54	0.00
July	25.05	29.83	32.60	39.66	0.00	0.00
August	24.00	26.43	30.01	0.00	0.00	0.00
September	32.55	24.63	28.24	0.00	0.00	0.00
October	0.00	27.20	33.05	0.00	0.00	0.00
November	0.00	29.14	0.00	0.00	0.00	0.00

APPENDIX D Cont.

Table 19
Minimum Return (%) per head without NTSP
Over the Entire Feeding Period

Month	450a	450b	450c	450d	550a	650a
November	-44.04	-51.58	-51.58	-29.39	-65.85	-81.46
December	-38.14	-44.23	-44.23	-24.79	-18.41	-22.00
January	-23.12	-30.08	-30.08	-11.00	-13.97	-26.01
February	-28.77	-34.93	-34.93	-16.17	-17.01	-14.03
March	-25.65	-31.55	-31.55	-14.54	-17.38	-10.04
April	-27.22	-29.84	-29.84	-22.77	-22.95	-7.83
May	-33.10	-36.10	-36.82	-16.44	-8.73	3.68
June	-25.27	-25.91	-27.52	-9.84	-9.04	0.00
July	-12.44	-9.70	-14.89	-7.63	0.00	0.00
August	-9.20	-7.08	-12.13	0.00	0.00	0.00
September	-7.88	-9.92	-10.57	0.00	0.00	0.00
October	0.00	-2.27	-7.51	0.00	0.00	0.00
November	0.00	-1.31	0.00	0.00	0.00	0.00

APPENDIX D Cont.

Table 20
Minimum Return (%) per head with NTSP
Over the Entire Feeding Period

Month	450a	450b	450c	450d	550a	650a
November	-53.95	-60.19	-60.19	-39.63	-70.20	-83.58
December	-38.14	-44.23	-44.23	-24.79	-24.61	-26.42
January	-23.12	-30.08	-30.08	-11.65	-16.46	-25.81
February	-28.77	-34.93	-34.93	-16.17	-17.01	-14.03
March	-25.65	-31.55	-31.55	-14.54	-17.38	-10.04
April	-27.22	-29.84	-29.84	-22.77	-22.95	-7.83
May	-33.10	-36.10	-36.82	-16.44	-8.73	5.71
June	-25.27	-25.91	-27.52	-9.84	-9.04	0.00
July	-12.44	-9.70	-14.89	-7.63	0.00	0.00
August	-9.20	-3.68	-12.13	0.00	0.00	0.00
September	-7.88	-5.64	-10.57	0.00	0.00	0.00
October	0.00	-2.27	-7.51	0.00	0.00	0.00
November	0.00	-1.31	0.00	0.00	0.00	0.00

APPENDIX E Profit Per Head Without NTSP

Table 21
Profit per head each year without NTSP

Month	450a	450b	450c	450d	550a	650a
Feeding Begins in October 1979						
11	38	30	30	48	-29	39
12	132	113	113	170	127	158
1	99	74	74	89	46	78
2	34	6	6	93	6	93
3	-74	-103	-103	-35	-78	-14
4	-134	-145	-145	-113	-132	-45
5	-200	-212	-221	-100	-59	39
6	-176	-171	-191	-71	-74	0
7	-79	-72	-104	22	0	0
8	-25	-16	-62	0	0	0
9	11	15	-20	0	0	0
10	0	64	35	0	0	0
11	0	118	0	0	0	0
Feeding Begins in October 1980						
11	15	9	9	31	5	12
12	-50	-59	-59	-30	-5	8
1	-44	-58	-58	-17	-4	-7
2	-76	-94	-94	-42	-49	-44
3	-88	-109	-109	-50	-40	-42
4	-80	-100	-100	-51	-34	47
5	-123	-106	-125	-39	32	66
6	-108	-83	-121	8	44	0
7	-82	-51	-106	1	0	0
8	-52	-27	-102	0	0	0
9	-79	-35	-103	0	0	0
10	0	-22	-84	0	0	0
11	0	-15	0	0	0	0

APPENDIX E Cont.

Table 21 Continued Profit per head each year without NTSP						
Month	450a	450b	450c	450d	550a	650a
Feeding Begins in October 1981						
11	8	5	5	24	11	5
12	22	15	15	38	-16	-18
1	-9	-19	-19	27	-9	-46
2	-2	-15	-15	26	-6	-22
3	10	-7	-7	38	10	40
4	22	2	2	52	38	192
5	43	62	50	181	296	337
6	77	86	63	213	232	0
7	114	116	82	212	0	0
8	123	134	92	0	0	0
9	143	150	116	0	0	0
10	0	143	113	0	0	0
11	0	177	0	0	0	0
Feeding Begins in October 1982						
11	4	0	0	26	32	18
12	24	16	16	43	18	-3
1	41	29	29	64	65	53
2	52	35	35	88	67	58
3	54	34	34	88	74	59
4	63	41	41	98	107	204
5	39	35	32	117	164	187
6	63	55	50	144	169	0
7	67	74	66	127	0	0
8	66	75	63	0	0	0
9	111	85	82	0	0	0
10	0	120	126	0	0	0
11	0	159	0	0	0	0

APPENDIX E Cont.

Table 21 Continued Profit per head each year without NTSP						
Month	450a	450b	450c	450d	550a	650a
Feeding Begins in October 1983						
11	10	6	6	23	8	-9
12	27	19	19	46	25	22
1	47	34	34	58	42	21
2	21	6	6	55	37	40
3	15	-4	-4	45	33	66
4	-9	-19	-19	10	7	134
5	-8	4	-8	63	107	139
6	0	11	-12	76	97	0
7	37	56	22	111	0	0
8	52	70	19	0	0	0
9	41	60	15	0	0	0
10	0	132	100	0	0	0
11	0	194	0	0	0	0
Feeding Begins in October 1984						
11	1	-3	-3	2	-11	-17
12	-1	-9	-9	15	-6	4
1	-5	-16	-16	24	7	-2
2	-10	-23	-23	19	-8	-7
3	-13	-31	-31	19	5	18
4	-25	-33	-33	-10	-23	35
5	-15	1	-12	40	60	88
6	3	13	-10	26	32	0
7	-66	-14	-50	-43	0	0
8	-58	-12	-65	0	0	0
9	-13	8	-36	0	0	0
10	0	140	110	0	0	0
11	0	169	0	0	0	0

APPENDIX E Cont.

Table 21 Continued Profit per head each year without NTSP						
Month	450a	450b	450c	450d	550a	650a
Feeding Begins in October 1985						
11	3	-1	-1	0	-5	-2
12	22	13	13	41	12	17
1	12	0	0	30	17	19
2	10	-5	-5	46	14	21
3	-31	-47	-47	11	-3	0
4	5	-1	-1	20	15	32
5	22	9	10	64	50	82
6	20	8	8	25	30	0
7	44	34	33	121	0	0
8	90	81	87	0	0	0
9	165	120	134	0	0	0
10	0	185	207	0	0	0
11	0	225	0	0	0	0
Feeding Begins in October 1986						
11	21	15	15	30	20	17
12	8	-2	-2	33	35	34
1	67	51	51	55	47	38
2	56	36	36	105	47	59
3	54	30	30	89	66	68
4	95	86	86	120	145	153
5	132	115	122	188	191	242
6	126	98	108	154	188	0
7	114	129	144	156	0	0
8	135	133	157	0	0	0
9	206	140	171	0	0	0
10	0	182	219	0	0	0
11	0	202	0	0	0	0

APPENDIX E Cont.

Table 21 Continued Profit per head each year without NTSP						
Month	450a	450b	450c	450d	550a	650a
Feeding Begins in October 1987						
11	-21	-27	-27	-15	-52	-90
12	19	6	6	49	-2	-29
1	34	16	16	13	-18	-53
2	-2	-24	-24	50	16	23
3	14	-12	-12	44	2	-10
4	-8	-1	-1	-2	4	9
5	-12	-25	-18	34	13	42
6	-18	-44	-35	-19	-7	0
7	-39	-12	-2	-13	0	0
8	-44	-41	-34	0	0	0
9	-25	-67	-55	0	0	0
10	0	-3	19	0	0	0
11	0	26	0	0	0	0
Feeding Begins in October 1988						
11	20	15	15	13	2	9
12	36	27	27	59	5	16
1	37	23	23	39	18	29
2	-19	-35	-35	16	-10	13
3	-6	-25	-25	28	-1	29
4	-41	-47	-47	-25	-40	1
5	-29	-19	-20	5	-22	16
6	-12	-22	-24	-26	-32	0
7	0	33	32	20	0	0
8	-1	14	14	0	0	0
9	8	-21	-16	0	0	0
10	0	49	62	0	0	0
11	0	84	0	0	0	0

APPENDIX E Cont.

Table 21 Continued Profit per head each year without NTSP						
Month	450a	450b	450c	450d	550a	650a
Feeding Begins in October 1989						
11	-8	-12	-12	2	-27	-3
12	-22	-29	-29	-2	-18	-1
1	-11	-23	-23	-11	-20	0
2	-17	-32	-32	19	-1	26
3	-38	-55	-55	-5	-25	14
4	-14	-30	-30	14	14	48
5	-4	-6	-8	28	9	57
6	55	43	41	20	30	0
7	18	41	39	50	0	0
8	23	41	42	0	0	0
9	70	38	44	0	0	0
10	0	84	98	0	0	0
11	0	135	0	0	0	0
Feeding Begins in October 1990						
11	14	9	9	19	25	18
12	39	30	30	60	26	13
1	36	23	23	32	29	3
2	31	15	15	69	29	18
3	48	28	28	80	69	49
4	61	58	58	74	91	54
5	68	64	66	73	29	34
6	97	77	83	28	46	0
7	57	97	107	53	0	0
8	-17	25	40	0	0	0
9	20	-21	-4	0	0	0
10	0	2	26	0	0	0
11	0	26	0	0	0	0

APPENDIX E Cont.

Table 21 Continued Profit per head each year without NTSP						
Month	450a	450b	450c	450d	550a	650a
Feeding Begins in October 1991						
11	-18	-23	-23	-9	-9	-20
12	-12	-20	-20	7	-1	-10
1	-14	-25	-25	-13	-7	-16
2	-12	-27	-27	23	-14	-17
3	11	-8	-8	35	23	22
4	18	17	17	28	50	31
5	4	13	18	41	48	70
6	-2	-20	-14	23	51	0
7	35	29	40	87	0	0
8	33	5	20	0	0	0
9	78	29	51	0	0	0
10	0	68	96	0	0	0
11	0	124	0	0	0	0

APPENDIX F Remaining Feeding Regimes Selective Hedging Results

Table 22
Feeding Regime 450b: Percentage Real Returns

	No Hedge	Prime + 4%	Prime +6%	Prime +8%	Prime +10%	Prime +12%	Routine Hedge
Excluding NTSP							
Average	15.59	13.64	15.18	15.71	15.93	16.77	11.08
STD.	9.71	8.61	7.18	6.69	7.43	7.42	11.06
Prime +4	9.96	9.80	9.15	9.06	9.78	10.20	12.10
Prime +6	9.24	9.52	8.47	8.23	8.97	9.23	12.34
Prime +8	8.96	9.69	8.27	7.88	8.59	8.65	12.91
Prime +10	9.16	10.29	8.58	8.07	8.71	8.56	13.77
Prime +12	9.80	11.25	9.36	8.76	9.31	8.97	14.88
RMSE	9.87						13.05
Including NTSP							
Average	17.72	15.78	17.30	17.83	18.06	18.90	13.24
STD.	8.37	6.79	6.05	6.01	5.51	5.29	9.11
Prime +4	9.82	8.97	9.39	9.76	9.69	10.19	10.39
Prime +6	8.57	8.12	8.18	8.47	8.33	8.70	10.21
Prime +8	7.68	7.74	7.38	7.55	7.32	7.50	10.45
Prime +10	7.30	7.91	7.11	7.12	6.81	6.74	11.09
Prime +12	7.50	8.60	7.44	7.30	6.92	6.58	12.06
RMSE	8.25						10.25

APPENDIX F Continued

Table 22 cont.
Feeding Regime 450c: Percentage Real Returns

	No Hedge	Prime + 4%	Prime +6%	Prime +8%	Prime +10%	Prime +12%	Routine Hedge
Excluding NTSP							
Average	12.12	13.95	14.76	13.25	13.25	12.32	9.72
STD.	10.79	11.47	11.06	10.75	11.60	10.89	12.87
Prime +4	10.03	11.88	11.79	10.19	11.03	10.19	13.39
Prime +6	10.09	11.60	11.35	10.01	10.86	10.20	13.82
Prime +8	10.57	11.68	11.28	10.26	11.09	10.64	14.54
Prime +10	11.42	12.13	11.59	10.91	11.69	11.44	15.50
Prime +12	12.55	12.90	12.25	11.89	12.61	12.54	16.67
RMSE	10.17						14.60
Including NTSP							
Average	13.84	15.66	16.47	14.97	14.96	14.04	11.46
STD.	10.21	9.90	9.59	9.80	10.80	10.28	10.86
Prime +4	9.62	10.89	11.06	9.61	10.58	9.77	11.26
Prime +6	9.29	10.22	10.24	9.02	10.04	9.40	11.44
Prime +8	9.42	9.95	9.79	8.88	9.92	9.49	11.98
Prime +10	9.99	10.11	9.78	9.23	10.23	10.01	12.85
Prime +12	10.94	10.68	10.20	10.00	10.93	10.92	13.97
RMSE	8.46						11.69

APPENDIX F Continued

Table 22 cont.
Feeding Regime 450d: Percentage Real Returns

	No Hedge	Prime + 4%	Prime +6%	Prime +8%	Prime +10%	Prime +12%	Routine Hedge
Excluding NTSP							
Average	14.32	13.20	14.06	14.79	17.31	19.31	11.64
STD.	14.75	14.43	13.43	13.45	12.27	13.28	16.05
Prime +4	15.19	14.35	13.48	13.68	13.54	15.42	16.16
Prime +6	14.91	14.23	13.21	13.30	12.74	14.42	16.27
Prime +8	14.92	14.42	13.27	13.24	12.23	13.66	16.63
Prime +10	15.22	14.89	13.65	13.50	12.07	13.19	17.24
Prime +12	15.80	15.63	14.32	14.07	12.27	13.04	18.07
RMSE	12.48						17.86
Including NTSP							
Average	15.82	14.68	15.58	16.31	18.82	20.80	13.14
STD.	13.23	12.20	11.77	11.78	10.45	11.24	14.00
Prime +4	14.12	12.42	12.26	12.57	12.77	14.67	14.22
Prime +6	13.58	12.01	11.68	11.88	11.63	13.37	14.11
Prime +8	13.35	11.96	11.46	11.52	10.78	12.29	14.30
Prime +10	13.45	12.27	11.62	11.54	10.28	11.48	14.79
Prime +12	13.86	12.91	12.13	11.93	10.00	11.02	15.54
RMSE	10.09						15.40

APPENDIX F Continued

Table 22 cont.
Feeding Regime 550a: Percentage Real Returns

	No Hedge	Prime + 4%	Prime +6%	Prime +8%	Prime +10%	Prime +12%	Routine Hedge
Excluding NTSP							
Average	13.86	14.98	16.89	17.27	18.61	18.48	12.79
STD.	18.19	14.99	15.03	16.05	16.24	16.54	16.91
Prime +4	18.44	15.74	16.49	17.60	18.32	18.53	17.46
Prime +6	18.27	15.38	15.89	17.00	17.57	17.80	17.41
Prime +8	18.33	15.30	15.55	16.63	17.04	17.30	17.61
Prime +10	18.63	15.50	15.48	16.51	16.76	17.04	18.05
Prime +12	19.15	15.97	15.69	16.66	16.93	17.03	18.71
RMSE	11.34						14.63
Including NTSP							
Average	14.65	15.80	17.69	18.06	19.39	19.27	13.62
STD.	16.86	13.89	13.72	14.47	14.55	14.99	15.79
Prime +4	17.28	14.95	15.65	16.51	17.23	17.53	16.48
Prime +6	17.00	14.45	14.90	15.75	16.32	16.66	16.32
Prime +8	16.96	14.24	14.41	15.24	15.65	16.01	16.43
Prime +10	17.19	14.33	14.22	15.01	15.23	15.62	16.79
Prime +12	17.65	14.72	14.33	15.05	15.09	15.50	17.40
RMSE	10.47						14.21

APPENDIX F Continued

Table 22 cont.
Feeding Regime 650a: Percentage Real Returns

	No Hedge	Prime + 4%	Prime +6%	Prime +8%	Prime +10%	Prime +12%	Routine Hedge
Excluding NTSP							
Average	25.14	24.82	25.54	24.97	25.66	26.90	20.08
STD.	23.22	12.87	12.01	13.42	14.02	15.36	16.40
Prime +4	27.26	19.51	19.51	20.09	21.02	22.92	19.39
Prime +6	26.23	18.08	17.99	18.69	19.61	21.50	18.51
Prime +8	25.33	16.78	16.60	17.42	18.32	20.21	17.84
Prime +10	24.57	15.66	15.36	16.32	17.19	19.05	17.39
Prime +12	23.97	14.75	14.32	15.43	16.25	18.06	17.17
RMSE	24.20						21.06
Including NTSP							
Average	26.05	25.74	26.47	25.90	26.59	27.82	21.04
STD.	22.05	11.10	10.46	11.95	12.57	13.83	15.68
Prime +4	26.79	19.11	19.36	19.85	20.79	22.61	19.27
Prime +6	25.66	17.53	17.72	18.31	19.25	21.08	18.27
Prime +8	24.66	16.07	16.17	16.90	17.83	19.66	17.47
Prime +10	23.80	14.76	14.76	15.63	16.54	18.36	16.88
Prime +12	23.09	13.64	13.53	14.56	15.43	17.21	16.54
RMSE	24.31						21.65